A MATHEMATICAL COMPENDIUM; OR, Useful Practices IN Arithmetick, Geometry, and Astronomy, Geography and Navigation, Embattelling, and Quartering of Armies, Fortification and Gunnery, Gauging and Dyalling

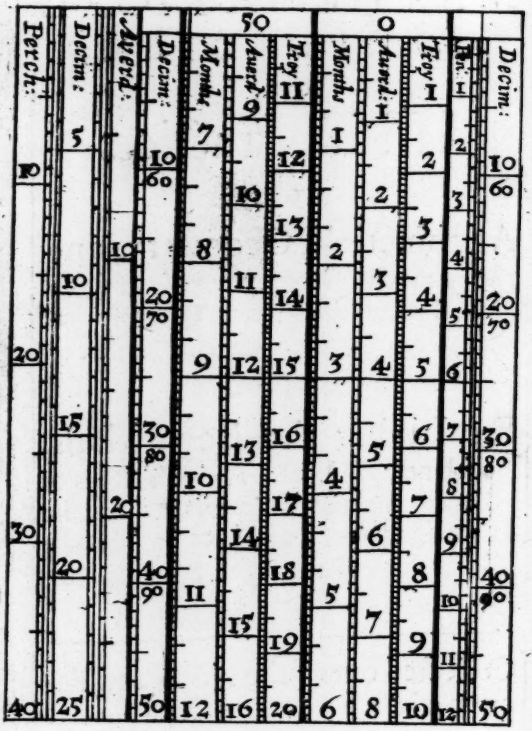
Explaining the Logarithms, with new Indices; *Nepair*'s Rods or Bones; making of Movements, and the Application of Pendulums: with the Projection of the Sphere for an Universal Dyal, &c.

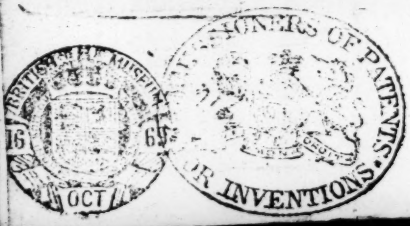
Collected out of the Notes and Papers of Sir *JONAS MOORE*.

By *NICHOLAS STEPHENSON.*

London, Printed and Sold by *Nathanael Brooke* at the *Angel* in *Cornhil*, 1674.

Decimall Tables





To the
HONOURABLE,
Sr JOHN WORDEN Kt
Secretary
To his
ROYAL HIGHNESS
JAMES
DUKE of YORK,
A Worthy Master in SCIENCES,

NICHOLAS STEPHENSON
Dedicateth these
COLLECTIONS.

The Principal Contents of this Book, with the page and number answering.

CHAP. I.

Of a Perpetual Kalender.

CHAP. II.

Of Weights and Meaſures, &c.

Meaſuring

CHAP. III.

Of Arithmetick, and its parts.

CHAP. IV.

Rules of Practice, *viz.*

The order of the Tables at the latter end of the Book.

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G 10. *A most excellent Table of the Stars that come under the North Pole, and their right Ascensions.* Lat. 51°. 32'.

This *Note* for the ready taking the height of the Pole, by the height of the Pole-Star, should have ended the Book, but wanting room I place it here: Consider the 23 *Fig.* where P is the North Pole, *ZPN* the Meridian, the Circle *ZdNb*, the Circle the Pole ✳ makes about the Pole, *Z* the Pole ✳ above, *N* under the Pole, *d* the Pole-star in any Quarter of the Circle, *PZ* or *PN* is the Radius = this year 1674 to 2°. 25'. 59", or 8759", and for every year to come substracting 20" it will be 1675 = 8739. 1676 = 8719, *&c.* Next thing to know, is the Right Ascension of the Pole ✳, which this year will be 9°. 1'. 46" at *Z*, and every year adding 1'. 45" to the former makes it to be 1675 = 9°. 14'. 40", 1676 = 9°. 16'. 34", *&c.* which must be turned into time, allowing every degree 4', *&c.* Substract the ☉ right ascension from the Pole ✳ right asc. leaves the time of the Pole ✳ right asc. at *Z* above the Pole, and adding 12 hours at *N* under.

Now by a true Pendulum Watch, at any time when you would find the Lat. having the time of the Night, take the Diff. betwixt the Pole ✳ right asc. at *Z* and that time, and turning that into deg. ' & ", it shews in what part of the Circle the P. ✳ is, and in what Quadrant, and the ∠ at P. *Lastly*, add the Log' of the Cosine of *d B o*, & *d B*, or *P z*, and substract Rad. it gives the Log. of Po. Now the height of the P. ✳ less or more Po. = height of the Pole.

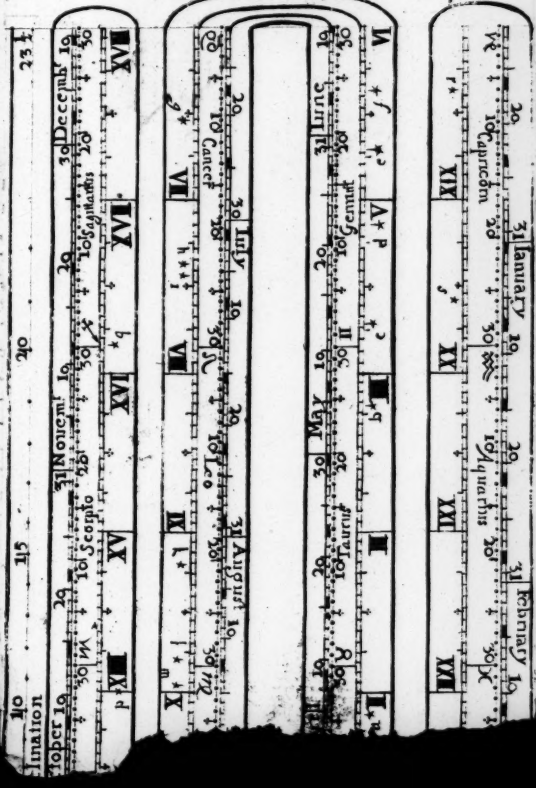
Modern Fortifications; or Elements of Military Architecture: By Sir *Jonas Moore*. Illustrated with several Figures.

CHAP. I.

Of a perpetual KALENDAR OR ALMANACK.

The uſes of three ſmall *Tables* for finding the Dayes of the Month, Suns place, Right Aſcention, the Prime, Epact, Moon, Tides, Stars, &c. for Ever.

The firſt Table or Figure.



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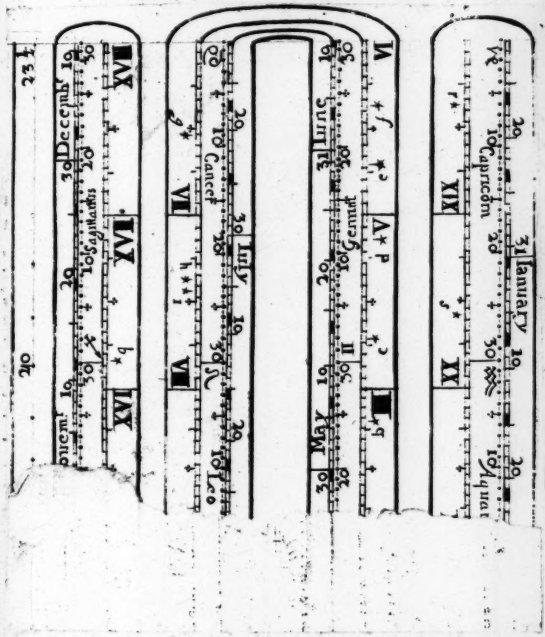


This Table begins the first of *January*, and contains the dayes of the Year; the first of *January* is made black, and so every seventh until the years end; there runs along in another Line the place of the Sun answering and opposite to the Dayes, (*viz.*) every degree of the Eccliptick from ♈ to ♓ through the whole Eccliptick, and near to this last Line, there runs a Line expressing the right Ascension of the ☉ or Star answering unto 24 hours, each hour is divided into 20 parts which are six minutes a piece; near it are placed small Asterisms with Letters by them for 20 of the principal Stars set down in the Third Table.

The Second Table or Figure.

This Table, Entitled an Almanack for 140 Years, has in the middle Dominical Letters, all the seven backward from A to B, above which are years past, and below years to come, with the Prime or Golden Number under the Years, and the Cycle of the Sun below: these years are expreſt by two Figures, and sometimes by one, and are all the Leap-years that are betwixt the Year 1600 and 1740, by explaining the lower row you will easily perceive all. In one Line there is 1660 begins, 1672. 1656. 1668. 1680. 1664, and 1676. follow, all which are Leap-years, and has to each Year the Dominical Letter above and Prime below, and those intermediate Years that are not Leap-years are to be supplyed. Suppose I begin at 1660 which hath G for Dom. Letter, and Prime 8; for 1661 it will have F for Dom. Let. and 9 for Prime, and is supposed to stand in the room of (72) For 1662 instead of (56) 1663 instead of (68) 1664 instead of (80) and then 1664; so that

Leap

An ALMANACK for 346 years

Jan:

Circumcis:	1
Epiphanie	6
Hil: Ter: be:	23
Car: 1: Mart	30

Feb:

Puri: Mary	2
*Shro: Tusd:	2
Hil: Ter: en:	13
Vallentine	14
S[t] Mathias	24

Mar:

Dauid Arch:	1
*East: ⊙ day	25
Lady day	25

Apr:

*East: Ter: be:	7
S[t] George	23

S[t] Mark	25
*Ascention d.	29

May:

S[t] Phil: & Iac	1
*East: Ter: en	3
*Whit: ⊙ day	9
Car 2 nat:	
*Trinity T: be	21

Iun:

*Trinity T: en	9
S[t] John Bap:	24
S[t] Peter ap:	29

Iul:

S[t] Iames ap	25

Aug:

Lamas	1

Years past	y	4	16	600	12	24	8	20
	p	9	2	5	17	10	13	6
	y	32	44	28	40	52	36	48
	p	18	11	14	7	19	3	15
Do: le		G	F	E	D	C	B	A
Years to come	y	60	72	56	68	80	64	76
	p	8	1	4	16	9	12	5
	y	88	700	84	96	8	92	4
	p	17	10	13	6	18	2	14
	y	16	28	12	24	36	20	32
	p	7	19	3	15	7	11	4
C: ☼		17	1	13	25	9	21	5

S[t] Barthol:	24

Sep:

Ex: ☥	14
S[t] Mathew	21
S[t] Mich: ar:	29

Oct:

S[t] Luke	1
Mich: T: be:	27
Simō & Iud	28

Nou:

All Saints	1
Mich: T: en	28
S[t] Andrew	30

Dec:

S[t] Thomas	21
Nat: Christ	25

A 2

Leap-

Leap-year is twice accounted, one for that part of the Year, from the beginning of *January* to the end of *February*, the latter for the other part of the Year, and has two Dom. Let. Further, 1672 is in the Table, but this preſent Year 1674 is not there, but imagined to ſtand in the place of 1668, and has D for the Dom. Let. and 3 for the Prime accounting from the laſt Leap year 1. On either ſide of the laſt Oblong are the Months in order, with the Feſtivals, Terms, and Notable Dayes in each Month, when they fall upon. The moveable Feaſts are marked with a ſmall ſtar, as in *February* Shrove-Tueſday, and in *March* Eaſter-Sunday, and have a day ſet to them, to which every Year another number being added makes them certain.

The Third Table or Figure.

This Table has on the left hand in four ſmall Columns, (1) The Prime expreſſed by Points and Figures down to 19; (2) The Epact anſwering to the Prime; (3) The Dominical Letter; (4) A number anſwering, which ſerves for aſcertaining the Moveable Feaſts. Next the former are the Names and Declinations of twenty principal fixed Stars, with the Letters of the Alphabet, to direct where theſe ſtars are to be found in the 1 Table for their right Aſcenſions, and the fourth Column ſhews whether their Declinations be North or South. The laſt thing in this Table obſervable, is, the New Moons or Changes; it has 13 Columns, the firſt are the Years of the Lord, every Tenth year expreſſed from the o which ſignifies 1600, and ſo you will find all the figures that ſtand right, which are 1, 2, 3, 4, 5, 6, 7, 8, 9. ſtand for 1610, 1620, *&c.* Then Δ ſtands for 1700, and ſo the Figures

Figures ſtand downwards till 1790, which is for 200 years; the intermediate years to be ſupplyed as was done in the Second Figure, for the years betwixt Leap-years.

Pr	Epa:	Do:le	Nu:
·	11	D	15
·	22	G	4
·	3	E	23
·	14	A	12
5	25	D	1
·	6	B	20
·	17	E	9
·	28	C	28
·	9	F	17
10	20	B	6
·	1	G	25
·	12	C	14
·	23	F	3
·	4	D	22
15	15	G	11
·	26	C	0
·	7	A	19
·	18	D	8
·	29	B	27

The Names and Decl: of fixed ſtarrs

a	♈ head	21.45	n
b	Whale	02.48	n
c	Buls eye	15.48	n
d	Goate ſtarr	45.47	n
e	Hum: Orion	06.01	n
f	Hum: Orion	07.18	n
g	Great Dog	16.14	s
h	Leſſer Dog	06.03	n
[illegible]	♊ head	28.46	n
k	Cor Hidræ	07.15	s
l	Cor ♌	13.33	n
m	Lumb ♌	22.20	n
n	♌ Taile	16.25	n
o	Virgi: Spike	09.31	s
[illegible]	Acturus	20.58	n
[illegible]	♏ hart	25.37	s
[illegible]	Harp ſtar	38.50	n
[illegible]	Vulture	08.03	n
t	Fomahant	13.22	n
v	Peg: Wing	13.28	n

The ☾ motion and Tyde

30 / 1	12 IIII	16	12 IIII
29 / 2	1 V	17	1 V
28 / 3	2 VI	18	2 VI
27 / 4	3 VII	19	3 VII
26 / 5	4 VIII	20	4 VIII
25 / 6	5 IX	21	5 IX
24 / 7	6 X	22	6 X
23 / 8	7 XI	23	7 XI
22 / 9	8 XII	24	8 XII
21 / 10	9 I	25	9 I
20 / 11	10 II	26	10 II
19 / 12	11 III	27	11 III
18 / 13		28	
17 / 14		29	
16 / 15		30	

The ☾ change

Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
9	6	5	6	5	5	3	1	9	8	8	6	6
8	5	3	5	4	3	2	1	0	8	8	6	6
1	4	2	4	3	2	1	1	9	8	7	5	5
3	3	2	3	2	1	6	8	7	6	5	4	3
5	7	0	1	0	9	8	7	6	5	4	3	3
7	1	0	1	9	9	7	7	5	4	3	2	1
9	9	8	9	6	8	6	4	4	3	2	1	1
1	9	7	8	7	6	5	4	3	1	1	0	9
3	8	7	8	7	6	4	4	1	9	9	8	8
5	7	6	7	6	6	3	3	1	9	9	7	7
7	6	5	5	4	4	2	1	0	8	7	6	5
0	4	3	4	3	3	9	9	6	7	6	5	4
2	3	2	3	2	2	0	0	8	7	7	4	4
4	2	1	2	1	0	9	9	9	6	6	4	4
6	1	6	9	6	8	7	6	5	4	4	3	2
8	0	9	0	8	8	6	6	4	3	3	1	1
∇	0	8	0	8	7	6	5	4	2	1	9	9
2	6	7	6	7	6	5	4	2	1	0	9	9
4	7	6	1	6	5	3	3	[illegible]	9	9	7	7

The Columns under the 12 Months expresse the day of the mean Change of the ☽ every month, if the Figure stand right; that is, with its head up it stands singly for so much, if it stand with its head to the right hand it signifies 10, and so many dayes besides, if towards the left hand then 20 and above, if downwards then 30 and above.

The particular use of the three Tables aforesaid.

Use 1. To find the Prime, Dom. Let. and Cycle of the ☉ for any year proposed.

Example, 1674 I find Table 2 among the years 72 last Leap-year, I tell on 1673, 74, where (68) stands, D is the Dom. Let. 3 the Golden Number (by accounting from 1 under (72) and 3 the ☉ Cycle. Again, if 1676 were proposed, G and A the Dom. Let. 5 the Prime, and 5 ☉ Cycle.

2. To find the Epact, in the third Table under the title of Epacts against the Prime, as against 3 the Prime, the Epact is 3, against 5 Epact 25.

3. To find what day the year begins on, because A is alwayes the first of *January*, if that be the Dom. Let. then it is Sunday, if any other, as in the year 1674 D, tell back to A, as D Sunday, C Saturday, B Fryday, D Thursday: All the black dayes in (Table 1) are Thursdayes that year, and having the Thursdayes the rest are had: And thus you may find whether any Lease or Bond be right dated, and what day of the week any day will fall on that is to come.

4. (Table 1) against the day of the week you may find the place of the ☉, and the right Ascension; as against the 25th of *March*, the 15 degree of *Aries* stands, and the right Ascension 3 h. and 8'.

5. The

5. The (2 Table) amongst the Months shews the Festivals and Termes if they be fixt; but for the Moveable that have a Star adjoyned, you must find how many dayes must be added each year to them to make them fixt; suppose 1674, 3 is the Prime, and D the Dom. Let. against 3 the Prime in the (3 Table) you have E the Dom. Let. and 23 a number, now tell how far distant E is from D forwards, *viz.* 6, which 6 added to 23 makes 29 to be added to the number against all the Moveable Feasts, to make them fixt for this year; *viz.* Shrove-tuesday being found on the second of *February*, add 29 makes it the third of *March*, and Easter-day the 19th of *April*.

6. For the twenty Stars, if any of these named come into the Meridian, or to any known hour of the night, find the Star in the (3 Table) and observe the Letter that answers; seek that Letter in the first Table, and find what right Ascension it hath, take the Suns right Ascension from it (but if it be less add 24 hours) and the difference in time added to the Stars hour gives the true time of the night.

7. To find what day the Moon changeth each Month; as in the year 1673, look in the (3 Table) against 7 account 1670, tell down, 71, 72, 73, (that is, where E stands downwards) it changeth in *January* the 8th day, in *February* 7, *March* 8, *&c.* (this is meant of the mean Change) If when you have got the day of the Change you place that in the Kalendar (Table 1) you may find the Moons age any day.

8. To find the Tides at *London* Bridge, you must very well observe the Column for the Moons motion and Tides in Table 3, where first you have small figures go down to 15 for the Moons Age; and again, from 16 to 30 in another for the Tides, which are presented by in-

ſpection in the two divided Lines into hours, and each hour into 6 or 12 minutes a piece, the Numeral Letters are for the Tides; as for Example, ☽ 8 dayes old, it is high water at 9 and 24 minutes, at 22 dayes old at 8 h. and 36′.

9. To find the length of the Moons ſhining; Here the Age of the Moon is accounted down in the firſt Column to 15, and up again to 30 in the ſame, and the time is expreſſed by the ſmall Figures amongſt the Numeral. As at 8 dayes old the ſhining is 6 h. and 24′. at 24 dayes 4 hours 48′.

10. For the Moons Riſing and Setting take this Rule.

Increaſ. { ☉ riſing more ☽ ſhining = ☽ riſing
☉ ſetting more ☽ ſhining = ☽ ſett.

Decreaſ. { ☉ riſing leſs ☽ ſhining = ☽ riſing
☉ ſetting leſs ☽ ſhining = ☽ ſetting.

11. To find the time of the night by the Moons ſhining on any Dyal; firſt, the Tides are three hours more than the ☽ Southing otherwiſe.

☽ Southing leſs by the ſhaddowed hour = Time in the Eaſt.

☽ Southing more the ſhaddowed hour = Time in the Weſt.

12. Theſe proportions are all near true, but not abſolute, becauſe they reſpect only the mean Motion, having not regard to the ☽ Latitude. With this Book may be had all the three Tables printed together to uſe alone.

CHAP.

CHAP. II.

Of Weights and Measures, of Metals, Water, &c. and other useful Notions.

1. *Measures of Application or Length are denominated from the parts of the Body, but are indeed in* England *taken from the Yard-Standard kept in* Guild-Hall; *the third part is a Foot, and the 36 part an Inch; expressed in this Table from an Inch to a Mile.*

Table of Long Square Measures.

Inch.	Palm.	Span.	Foot	Cubit	Yard	Ells.	Pace.	Fadom.	Poole	Furlong.	Mile.
3	1										
9	3										
12	4	1⅓									
18	6	2	1½								
36	12	4	3	2							
45	15	5	3¾	2½	1¼						
60	20	6⅔	5	3⅓	2½	1¼					
72	24	8	6	4	2	1¼	1¼				
198	66	22	16½	11	5½	4⅘	1⅗				
7920	2640	880	660	440	220	176	132	110	40		
63360	21120	7040	5280	3520	1760	1408	1056	880	320	8	Mile.

Acres	Rood	Pole	Pace	Yard	Feet	Inch.
4						
160	40					
17429	4356	1089				
4840	1210	302½	227			
43560	10890	2722½	25	9		
		39204	36000	1296	144	Inch.
						Turn.

Turn the ſide to you, and then this Table of long Meaſures, (as all the reſt after) may be conſidered as to the Columns or Spaces betwixt line and line from top to bottom : or linear, or by lines from the left to the right. The Column is of the ſame name as at the top ; ſuppoſe inches, 3, 9, 12, 18, *&c.* are all inches : But in the line do ſeverally belong to the name at the end of the line ; as 36 Inches, 12 Palms, 4 Spans, 3 Feet, 2 Cubits make ſeverally a Yard.

Square Meaſures or Superficial are contained in the other Part ; as, One Pole ſquare are $10,89$ ſquare paces, $30\frac{1}{4}$ ſquare yards, $172\frac{1}{2}$ ſquare feet, 39204 ſquare inches. In the Table of long Meaſure it is ſaid a Pole or Perch is $16\frac{1}{2}$ feet which is the Statute Perch ; beſides which there are other cuſtomary Perches or Poles, *viz.* 18 Feet for Fenns and Wood-land, 21 for Forreſts, *Lancaſhire* and *Iriſh* Meaſure, and $18\frac{3}{4}$ *Scotch.*

The Meaſure for Horſes is by the handfull = 4 Inches.

How theſe Meaſures of ours agree with others abroad ; ſee a Table printed in Modern Fortifications ; and at the latter end of the Book.

The Ell is five quarters of a Yard, and has 20 Neyles ; as a Yard has 16 ; $\frac{1}{5}$ of an Ell = $\frac{1}{4}$ of a Yard. A *Dutch* Ell or Stick is Three Quarters of a Yard by which Tapeſtry is meaſured.

2. Before we come to Meaſures of Application, which depend much upon Weights, we will treat of Troy and Averdupois weight : By Troy weight, Gold, Silver, Jewels, Amber, Electuaries, Bread-corn, Liquors, are weighed, and from this Troy Pound are taken all Meaſures for Wet and Dry Commodities.

Averdupois weight weighs all manner of things that

that can waſt, and though the Pounds Averdup. be greater than the Pound Troy, yet the Ounce is leſs. The Pound Troy is divided into Ounces, Peny-weights, Grains, &c. and the ℔ Averd. into Ounces ℥, Drams ʒ, Scruples ℈, Grains Gr. The Tables follow.

Troy Weight.				Apoth. Weight.				
Grains.				Gr.				
24	Pen. wt			20	℈			
480	20	Ounc.		60	3	℥		
5760	240	12	lib	480	24	8	℥	
				5700	288	96	12	℔

Apothecaries make up their Medicines by the laſt Table of Troy weight, but buy and ſell Druggs by the Averd.

Scruples		Averd. Weight.			
3	Drams				
24	8	Ounces			
384	128	16	pound		
43008	14336	1792	112	Hund.	
860160	286720	35840	2240	20	Tun

The great Hundred is alwayes 112 l. and 20 of theſe makes a Tun. Eighty Ounces Averd. make near 73 Ounces Troy; which is 5 l. Averd. to 6 l. Troy, which ſhews the Ounces Averd. leſſer, and the l. Averd. greater than the Ounces or l. Troy.

Dr. *Wiberd* who was very diligent makes 14 l. Averd. equal to 17 l. Troy; therefore let this proportion hold; { Troy l. to Averd. l. 17. 14. / Troy oun. to Av. ou. 51. 56.

And

And by very good Experiments of him and others, it will be very useful to know that one Ounce of pure running or rain water Troy will fill 1,8949 inch. & 1 oun. Averd. 1,72556 inch. one l. Troy will fill 22,7368 solid inches, and 1 l. Averd. 27,609; one solid foot will hold 76 l. Troy, and 62,588 Averd.

A Tun weight Averd. is alwayes 20 C. of all things, except Lead, which is 19 C. and a half. Allum, Cinnamon, Nutmegs, Pepper and Sugar has $13\frac{1}{2}$ l. to the Stone, and 108 l. to the C. *Essex* Cheese or Butter the Clove is 8 l. the Wey 32 Cloves, or 256 l. In *Suffolk* the Clove is 8 l. the Wey 42 Cloves, or 336 l. Hay should have 20 C. but is sold for 18 C. 36 Trusses, or 2016 l. Wooll is sold by the Clove or half Stone 7 l. by the Stone 14 l. Tod 28 l. Weigh 182 l. Sack 364 l. Last 4368 l. Iron and Shot are weighed 14 l. to the Stone, 28 l. to the Quarter, 112 l. to the C. 20 C. to the Tun. A Faggot of Steel is 120 l; a Burden of Gad Steel is 9 score, or 180 l. For the weight of Butter and Sope 56 l. of Butter, and 60 l. of Sope make a Firkin, and 4 Firkins a Barrel of either.

3. *Dry Measures* of Capacity, are raised from the Gallon, containing 8 Pints, which should be contained in $272\frac{3}{4}$ Cubick Inches, and should hold of pure running or rain water 9 l. 13 oun. 12 dr. $\frac{1}{2}$ of Averd. weight. Therefore to come to a true Gallon for dry measure, if you make a square Vessel that shall have all the sides 6 inches, and 48 hundred parts of an inch, and just so deep; or if you weigh with Averd. weight 9 l. 13 oun. and 12 drams of clean rain or running water, either of these will find out a Gallon Dry Measure.

Pints

Corn measure.

	Pints	Gal.	Pec.	Bush	strik.	Carnock or coomb	Seam rafer or quart.	Wey	
	8								
	16	2							
	64	8	4						
	128	16	8	2					
	256	32	16	4	2				
	512	64	32	8	4	2			
	3072	384	102	48	24	12	6	Wey	
	5120	640	320	80	40	20	10	12	Laſt.
A	1 l.	8 l.	16	64	128	256	512	3072	5120
B	140	7 l.	14	56	1 C.	2 C.	4 C.	24 C.	40 C.

The Number in the Line A. expreſſeth in pounds Troy the weight of Wheat in all the Meaſures, in B. Averd. weight.

Meal is weighed as Corn, but the Common repute is, that a Gallon of wheaten Meal weighs 7 l. Averd. and 8 l. 6 ou. 4 d. weight Troy; and ſo a Buſhel 56 l. Averd. and 68 l. 1 ou. 12 d. weight Troy. All other Grain; likewiſe Salt, Lime, Coles, *&c.* follow this meaſure, which is called *Winchester* Meaſure: But note, that as Sea-Cole and Salt are meaſured with this Buſhel, then they are heaped, or elſe there is allowed five ſtriked Pecks to the Buſhel; and this is called Water-meaſure; 36 ſuch Buſhels are a Chaldron of Coles; and on ſhip-board they allow 21 Chaldron to the Score.

4. Liquid meaſure, is either Wine, or Ale and Beer meaſure. The Gallon for Wine meaſure contains 231 Cubical inches, and ſhould hold of pure rain or running water, 8 l. 1 oun. 11 dr.

Averd. and 91. 10 oun. $1\frac{1}{4}$ d. Troy; Therefo
to get a true wine Gallon, make a ſquare veſſ
that ſhall have all the ſquares and depth 6 inche
and 13 hundred parts of an inch, or if you weig
with Averd. weights 81. 1 oun. 11 dr. of pur
running water; either of theſe will find out
true Gallon of Wine meaſure.

A Table for Wine meaſure.
A Tun of Wine weighing Averd. 17 C. weight.
One Pint 11. $0\frac{1}{2}$ ounces Troy.

Pints	Gall.	Rundl.	Barr.	Terce	Hogſh.	Puncion	Butt	Tun
8	1	$\frac{3}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{2}$		
144	18	1	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{2}$		
252	$31\frac{1}{2}$	$1\frac{3}{4}$	1	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{2}$		
336	42	$2\frac{1}{3}$	$1\frac{1}{3}$	1	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{2}$	
504	63	$3\frac{1}{2}$	2	$1\frac{1}{2}$	1	$\frac{1}{2}$	$\frac{1}{3}$	
672	84	$4\frac{2}{3}$	$2\frac{2}{3}$	2	$1\frac{1}{3}$	1	$\frac{1}{2}$	
1008	126	7	4	3	2	$1\frac{1}{2}$	1	
2016	252	14	8	6	4	3	2	2 Tun

5. The Gallon for Ale or Beer holds 282 ſo
lid inches, and weighs of pure water 10 l. 3 ou
$\frac{426}{1000}$. Therefore the ſquare veſſel ought to be
6 inches, and 55 hundred parts of an inch each
way, and the water 10 l. 3 oun. $\frac{42}{100}$ to find
this Gallon.

A Table

A Table for Beer.

Pints	Gall.	Firk.	Kild.	Barrel	Hog.
8					
72	9				
144	18	2			
288	36	4	2		
576	72	8	4	2	

Ale.

Pints	Gall.	Firk.	Kild.	Barrel	Hog.
8					
64	8				
128	16	2			
256	32	4	2		
512	64	8	4	2	

Note that veſſels for Butter, Fiſh, Sope follow
e Ale Meaſure of a Gallon; 8 Gallons makes
Ferkin, 2 Firkins a Kilderkin, 2 Kilderkins an
le Barrel, and 12 Ale Barrels a Laſt.

6. Tale and number of ſeveral goods.

Of Canvas cloth, the C. is 120 Ells; of Fu-
ion 1 Chef is 14 Ells; of fine Linnen, Silk and
yndon 10 Ells.

Codfiſh, Haberdine, Ling, *&c.* has 124 to the
. and 1240 the M. Eeles 25 to the ſtrike, and
o ſtrike to the Bind. Of Herring 120 to the
12 C. to the M. laid in a Barrel, and 12 Bar-
els to a Laſt.

Tale of Furrs. Filches, Grayes, Jennets, Mar-
ns, Mincks, Sables, 40 skins is a Timber: other
kins 5 ſcore to the C.

A Seam of Glaſs is 24 ſtone, or 120 l.

One Bale of Paper is 10 Ream, a Ream 20 Quire, a Quire 25 ſheets.

One Rowle of Parchment is 5 dozen, a dozen 12 Skins.

Ten Hides are a Dicker, a Laſt 20 Dickers.

Ten pair of Gloves a Dicker; and ſo 10 Horſe-ſhoes.

Tale of Fuel. All Billets ſhould be 3 foot long; and ſo all Faggots, and the band beſide the knot 24 inches round, and not flat.

A Laſt of Powder is 24 Barrels or Firkins, which muſt hold 100 l. neat.

Timber is ſold either by the Tun or Load; a Tun is 40 feet; a Load 50 feet ſolid.

7. Of Gold and Silver. They are near the proportion of 12 to 1; therefore if an Hebrew Talent of Silver be valued at 375 l. that of Gold will be 4500 l.

The value of Gold here in *England* is as follows. One penny weight of Angel Gold is worth 4 s. 2 d. ob. of Crown Gold 3 s. 10 d. ob. of Sovereign 3 s. 6 d. ob.

One pound Sterling money ought to have 11 ounces 2 penny weight fine Silver, and 18 p. weight Allay.

Fineneſs of Gold is eſteemed by the Karract, no certain weight, but the $\frac{1}{24}$ of any quantity: this Karract is divided into grains and parts.

The Karract that weighs Jewels, is divided into 4 gr. of which grains 20 make 24 gr. Troy, or 1 pen. weight.

8. Metals, Stone, Liquors, Grain, *&c.* are compared as in the Table following; where there are 4 Columns; the firſt contains the names of them; the ſecond Column A has their weights in Troy ounces anſwering to a Cubick inch of Magnitude; the third Column B has their Magnitude in inches and Decimal parts, anſwering

swering to one Oun. of weight Troy; the third Column C is the weight of a Cubick inch in the water, in Troy ounces and Decimal parts.

	Ou. A	inch. B	C
☉ Gold	9.91735	0.10083	9.33962
☿ Quicksilver	7.93388	0.12604	7.35615
♄ Lead	6.16198	0.16229	5.58425
☽ Silver	5.50083	0.18179	4.92310
♀ Copper	4.81322	0.20776	4.23569
♂ Iron	4.27715	0.23380	3.64942
Cast Iron	3.96821	0.25253	3.39048
♃ Tinn	3.96694	0.25208	3.38921
Marble	1.59631	0.62644	1.01858
Common stone	1.09835	0.91045	0.52062
Honey	0.79339	1.26042	0.01566
Water, Wine	0.52773	1.89490	0.00000
Oyl	0.47603	2.10069	
Wheat	0.37628	2.65757	
Dried Oak	0.04745	1.75609	

The uses of this Table will appear hereafter in the Rules of Practice.

		l	s	d		l	s	d
Troy wt. 1l. Gold‖ Averd.wt. 1l.gold‖	is worth	40	18	4 3/4	silv.	3	2	0
		49	13	8 1/4	silv.	3	15	3 1/2

So that 100 l. in Gold weighs only 11. 11 oun. 3/4 and 100l. in silv. mony will weigh 261.9. ou. Av.

You may find by the former Rule and Table, that one cannot well be cheated by the bulk of gold, and other metals by reason of the weights.

To end this Chap. I have added the Assize of Bread in Averd. weight; a very useful Table to correct Bakers: the Town Bakers prizes being on one side, Foreigners on the other; the Table in it self will be information sufficient. The Officers in towns, and Justices of Peace in the countrey ought to observe these Rules: on the right side and left there is set down the price of a bushel of Wheat, and if the Bakers want one ounce in 36 to suffer the Pillory.

The Assize for Bread for all WEIGHTS.

Free town Bakers — Weight of a penny Loaf. — Troy — Averd. — Eoreign-ers.

s	d	white	wh.	hou.	white	wh.	hou.	s	d
2	0	16 13	25 4	33 11	15 7	23 1	30 15	2	2
2	3	15 7	25 3	30 14	14 2	21 3	28 4	2	6
2	6	14 4	21 6	28 8	13 0	19 10	26 0	2	9
2	9	13 3	19 13	26 7	12 1	18 2	24 3	3	0
3	0	12 5	18 8	24 11	11 5	16 18	22 11	3	3
3	3	11 9	17 6	23 3	10 11	15 17	21 3	3	6
3	6	10 14	16 5	21 13	9 19	14 18	19 18	3	9
3	9	10 5	15 7	20 9	9 8	14 2	18 16	4	0
4	0	9 12	14 10	19 8	8 18	13 7	17 16	4	3
4	2	9 4	12 14	18 8	8 9	12 12	16 1	4	6
4	6	8 13	13 4	17 10	8 1	12 1	16 2	4	9
4	9	8 7	12 10	16 14	7 13	11 10	15 7	5	0
5	0	8 1	12 1	16 2	7 7	11 0	14 14	5	3
5	3	7 11	11 9	15 7	7 1	10 11	14 2	5	6
5	6	7 6	11 2	14 13	6 15	10 3	13 10	5	9
5	9	7 2	10 11	14 4	6 10	9 15	13 0	6	0
6	0	6 14	10 4	13 11	6 5	9 8	12 10	6	3
6	3	6 10	9 15	13 4	6 0	9 1	12 1	6	6
6	6	6 6	9 9	12 12	5 16	8 15	11 13	6	9
6	9	6 3	9 4	12 6	5 12	8 9	11 5	7	0
7	0	5 15	8 15	11 15	5 9	8 3	10 18	7	3
7	3	5 12	8 11	11 9	5 5	7 18	10 11	7	6
7	6	5 9	8 6	11 3	5 2	7 13	10 5	7	9
7	9	5 7	8 3	10 14	4 19	7 9	9 19	8	0
8	0	5 4	7 15	10 9	4 16	7 5	9 12	8	3
8	3	5 2	7 12	10 5	4 14	7 1	9 8	8	6
8	6	5 0	7 8	10 0	4 11	6 17	9 2	8	9
8	9	4 14	7 5	9 12	4 9	6 13	8 18	9	0
9	0	4 12	7 2	9 8	4 6	6 10	8 12	9	2

CHAP.

CHAP. III.

OF ARITHMETICK and its PARTS;

And of the moſt eaſie performance of Multiplication, Diviſion and Extraction of the Roots by *Nepayres* Rods : The uſe of the Table of Logarithms herewith Printed : Decimal Tables, Progreſſion and Proportions.

§ 1. OF the ſix Principal Parts; Numeration, Addition, Subſtraction, Multiplication, Diviſion and Extraction of the Roots; but firſt notice muſt be taken of theſe few Characters :

+ Addition or more	Diviſ.) Divid. (Quot.
− Subſtraction or leſs	Z Summ
X Multiplyed by	X Difference.
= Equal to	

1. Numeration gives the value we place upon the 9 Digits; the firſt place is of ſimple Unity towards the right hand, next Hundreds, next Thouſands, *&c.* and ſo each place ten times more to the left hand; as you may ſee by the value of this number; 75. 832 which is 75 thouſand 832.

And as this increaſeth towards the left hand, in a Decuple proportion, ſo may all parts or fractions of any whole thing decreaſe fron Unity in the ſame proportion towards the left; as that after Unity to be Unity into 10 parts, the next into 100 parts, *&c.* and though we in *England*

do not divide our money, or measures into these parts, yet to make Arithmetick easie, we turn our accounts into it: and for the better understanding hereof, take notice that at *Rome* their money consists in Ducats, Julios, Baioccas: Ducats is their Integer or whole Unite; ten Julio's makes a Ducat, and ten Baioccas a Julio: So that to express 35 Ducats, 8 Julio's, and 7 Baioccas, they set them thus; 35,87 that in respect of Julios it is $\frac{8}{10}$ of Baioccas $\frac{7}{100}$ parts of a Ducat; This is the true Decimal Arithmetick or Natural: But to break into other parts is inartificial, as $\frac{2}{3}$ imagines the whole divided into 3 parts.

2. Addition whether whole or parts takes the general Summ, and Substraction the difference; keeping certain, that Unite be kept under Unite: Suppose the *Ex.* here Ducats, Ju. and Ba. the summ would be 3547 Ducats, 3 Julios, and 8 Baioccas.

Ex.	357, 28	
	92, 7	
	315, 89	
	2781, 51	
(z)	3547, 38	

Ex. From 562 Ducats, 8 Jul. and 4 Ba. take 381 Duc. 2 Jul. and 7 Baioc.

Ex.	562, 84	After Substraction there remains 181 Duc. 5 Jul. and 7 Bai.
	281, 27	
	181, 57	

Of these Parts no more; if any Gentleman or other, especially Ladies, that desire to look into their disbursements, or layings out, and yet have not time to practise in Numbers, they may from Mr. *Humfrey Adamson* dwelling near *Turn-stile* in *Holburn* have those incomparable Instruments, that will shew them to play Addition and Substraction in l. s. d. and whole numbers, without pen, ink, or help of memory; which were the Invention of that worthy person, and Ornament of his Country, Sir *Samuel Moreland* Barronet.

3. Mul-

3. Multiplication by memory is fit for thoſe that have conſtant practice, but for certainty and eaſe no Invention ever came near that of the Lord *Nepair* by Rods, made either of Wood or Ivory. Sir *Samuel Moreland* has deviſed a neat way upon Circles, but vaſtly chargeable, and that has been the reaſon why they have not been ſo well known. I have at laſt clothed ſticks with papers printed, and at very eaſie charge they are to be had ready varniſhed, better for uſe than made of Silver, and ſold with this Book as one, with one or more papers ready to be paſted upon ſticks, if the Box ſhould be loſt, and cannot be falſe.

To double or treble a number will be found ready by any one, as to double 7584, ſay twice 4 is 8, twice 8 is 16, ſetting down 6, and bearing one in mind; twice 5 is 10, and 1 I carried is 11, ſetting down 1 and carrying 1; twice 7 is 14, and 1 is 15, all which is 15168. the ſame for multiplying by 3.

Before I come to the uſe of the Rods, it will be very fit to ſhew how Multiplication may be wrought by making a Table of the Multiplicand to 9 as follows; ſuppoſe I would multiply 6831 by 693, I take the Multiplicand 6831, and making a line before it, I ſet down the Digits to nine, I double it and ſet it againſt 2, I add the firſt and ſecond for 3, I double that againſt 2 for 4, add the ſecond and third for 5, double the 3 for 6, add the third and fourth for 7, double the fourth for 8, and add the fourth and fifth for 9: ſee the Table,

Table X.

1	6831
2	13662
3	20493
4	27324
5	34155
6	40986
7	47817
8	54648
9	61479

6831 Multiplic.
692 Multiplier.

20493
61479
40986

4733883 Product.

Now ſet down the Multiplicand and Multiplier, and ſet in the Table the number againſt 3, and ſet it down: againſt 9, and ſet it one place to the right hand, againſt 6, and ſet ſtill one place further, as in the *Ex.* whereby adding all the three Multiplees you have the General Product 4733883. You may try with leſſer numbers, and perfect this way in an hours time.

The Rods being ſet together makes this Table at one work for preſent view.

Firſt then having the Box open, you are at the firſt ſight to know what figures ſtand on each ſide of the Rod; that next to you is fair, that under it, or the ſide the Rod lies on, is the complement to 9, and the figures on both ſides of the Rod are ſeen at the bottom by two ſmall figures under the black Line; ſuppoſe you ſee the Rod 6 upwards, you will know 3 the remains to 9 is under, and at the bottom you will ſee 1 on one ſide and 8 on the other; ſo at one glance you have four figures, know 6, 3, 8, 1, and this is proper to each Rod, and muſt be perfectly learnt. From hence you may find, that 10 Rods have all the Digits four times over, that is four 1, four 2, four 3, four 4, *&c.*

Having learnt quickly to find a figure, the next is to place the Multiplicand upon the Rods, ſuppoſe in the *Ex.* 6831, I find theſe 4 figures as before, and placing 6 next the Index (fixt in the Box) then 8, then 3 and 1; the Digits are then Tabulated, and againſt every Digit in the Index you have the very ſame figures as in the Table

Table aforegoing, to be found with this caution, that you begin at the right hand, and taking out firſt the ſingle figure that ſtands in a triangle, after that you muſt take the two figures that ſtand in the Rombus, if there be two, and if both be under 10 write the ſumm down as one figure, if above 10 write the ſarpluſage above 10 down, and carry one to the next ſell, but all will be better ſeen from the Rods themſelves than 100 times from words: See the (firſt figure) in the laſt page where you will find the former number 6831 on the top, and againſt 2 (which is two times the number) you have in the triangle firſt 2, then in the next Rombus 6, next 2 and 1, which you ſet down as 3, laſt 1, which makes 13662 as in the former Table; next ſix times is firſt 6, then 8, then (8 and 1) = 9, then (6 and 4) = 0, then (3 and 1) = 4; ſo the whole will be 40986, and nine times will be 9, 7, (2 and 2) 4, (4 and 7) 1, (5 and 1) 6, (61479) as in the Table before; a ſmall labour will make you read the Rods as quick as you may ſee them in the Table either backward or forward.

If there be any Decimal parts in the one or both Md or Mr tell their number of places, for there muſt be as many places cut off by the diſtinction as were in both.

Multiply 37, 5 that is 37 Duc. and 5 Jul. by 15, 91 that is 15 Duc. and 9 Jul. and 1 B. you ſhall have the Product 596, 625, that is 596 Duc. 6 Jul. 2 Baioccas and a half; there are 3 places cut off becauſe there was 1 in the Multiplicand, and 2 in the Multiplier.

4. Diviſion has no more difficulty than formerly, tabulate the Diviſor on the Rods, one Example will be ſufficient; let the Dividend be 4733883, the Product in the former Example, let 6831 be the Diviſor to be tabulated on the Rods,

Rods, you have the Multiplying of it to 9 before, which is here repeated.

1	6831	Divisor	Dividend	Quotient.
2	13662	6831)	4733883 (	693
3	20493		40986··	
4	27324		63528	
5	34155		61479	
6	40986		20493	
7	47817		20493	
8	54648		0	
9	61479			

The Table of the Divisor stands for the Rods, first, I see that 6831 will not be in 4733, therefore you must go 5 places; then looking on the Rods, or in the Table for a number that is equal or next less to 47338, I find it to be 40986, that is 6 times the Divisor, I set 6 in the Quotient, and substract 40986 from the figures above, rests 6352, to which I add 8 the next figure of the Dividend, and seek again upon the Rods or Table for it, or the next less, which I find to be 9 times, I set 9 in the Quotient and take 61479 plac'd as in the Example, and substract it, remains 2049, to which I add 3 the last figure, and work as beforesaid, 3 times carries all away and nothing remains, the Quotient being 693.

For Decimal parts there must be as many places in the Divisor and Quotient as are in the Dividend, in this Example,

15,91)	596,625 (37,5	In the Dividend there are 3 places, in the Divisor 2, therefore the Quot. must have 1 decimal place, which is 37 Ducats,& 5 Julios; and in case there
	477 2··	
	11932	
	11137	
	7955	
	7955	
	0	

there be no Decimals, or fewer in the Dividend than Diviſor, put as many Cyphers as you pleaſe after the Dividend, which are decimal places, and if you find that there be defect in the Quotient put Cyphers before it, to ſupply the places.

5. Extraction of the ſquare Root has ſome difference, but not much, from Diviſion. (1.) Point each other figure beginning with the laſt, as in the Example, 6, 5, and 7, which ſhews there will be 3 figures in the Root. (2.) Take the Rod called the ſquare Rod that has at the top ſquare, and ſet it to the Index, and ſeek for the figures to the firſt prick (57) you will find 49 neareſt, ſet 7 in the Quotient, and ſubſtract 49 from 57, reſts 8. (3) To this remainder (8) add the next two figures to the next prick (15) makes it 815. (4) double the Quotient 7, *viz.* 14, and ſet it upon the Rods, and place thoſe Rods betwixt the Index and ſquare Rod, each time after the firſt work: ſeek then upon the Rods for the next leſs or equal number to the figures 815, which I find to be 725, that is 5 times; ſetting 5 in the Quotient, ſubſtract, and to the Remainder add 2 places to the next point (365) laſtly, double the Quotient 75, which is 150, ſet this betwixt the Index and ſquare Rod, and work as before, you will find the Root 756, which multiplied by it ſelf produceth the ſquare number 571536. If your Root be not perfect, but ſomething remains after the laſt ſubſtraction, add Cyphers to the ſquare and proceed.

```
. . .
571536 (756
49 . .
14) 815
    725
150) 9036
     9026
```

6. Extraction of the Cube Root; (1.) point every third figure from the laſt, ſet the Cube Rod that hath Cu. on the head, to the Index in

the Box, ſeek the next leſs on the Rod, which is in the Example 64, that is 4 times, ſet 4 in the Quotient and ſubſtract, reſts 27, to which add 2 figures to the next point, the ſumm is 27733. (2.) Square the figure found in the Quotient and triple it (and this muſt be done each time) for a Diviſor, which ſet betwixt the Index and Cube Rod, in this Example, 4 being in the Quotient multiply it by it ſelf makes 16, and that multiplied by 3 makes 48, which on 2 Rods I place in the Box betwixt the Index and Cube Rod for a Diviſor. (3) Seek a Quotient which will be found 5, which ſet down, and the number anſwering 24125 place as in the Example; but before you ſubſtract you muſt triple the Quotient 4, which is 12, and multiply it by the ſquare of the laſt figure 5, *viz.* 25; now 25 by 12 makes 300, which place under 24125 one place forward to the left hand as in the Example; then add thoſe two numbers makes 27125, and ſubſtract it reſts 608. This work muſt be repeated for each figure in the Quotient, *viz.* to 608 add 851 for a Reſolvend, ſquare 45 and triple it makes 6075 for a new Diviſor, which being placed next before the Cube Rod, ſhews it will be but one for the Quotient, which anſwers to 607501 which is ſet down, and tripling 45, and multiplying it by 1 makes 135, which ſet one ſhort, makes in the whole 608851, ſo that nothing remains. If ſomething remain add Cyphers, 3 for a figure, and it will give a Decimal fraction.

```
  .   .   .
91733851 (451.
  64  .   .
-----
48) 27733
    24125
      300
    -----
    27125
-----------
6075) 608851
      607501
         135
      ------
      608851
```

Thus

Thus much with a little practice, and that the Boxes are to be had with the Book will render all General, and it would too much augment this ſmall Volumn, to teach the uſe and making of Duodecimal Rods, Sexagenary for the old Aſtronomy, and Centeſimal, all which works two figures at once.

7. *Napaires* Rods will reach to great Numbers, but for Numbers under 100000, the ſaid worthy Lord invented a far eaſier way to perform Multiplication by Addition, Diviſion by Subſtraction, Extraction of the ſquare and Cube Roots by halving or triſecting, and all this by certain Numbers in a Table called *Logarithms*, printed at the end of the Book, wherein the firſt page all Log. anſwering to all numbers under 100 are eaſily found, *viz.* the Log. of 38 is 1.579783, of 72 is 1.857332, *&c.* If the number conſiſts of 3 places, that is a number under 1000, look for the number in the Table under N. and the Log. is found in the Column under 0, ſo the Log. of 349 is .542825, of 893, is .950851. If the number be of 4 places and under 10000, ſeek the 3 firſt figures under N. as before, and the laſt figure on the top, under which in that Column lineally againſt the firſt 3 figures you have the Log. As for Example; The Log. of 3583 is :554247, finding 358 under N. againſt which in the Column under 3 is that Log. ſo the Log. of 4268 is 630224, of 9546, is :979821 : But if the number be above 10000 and under 100000 you muſt find it by the difference, and Table of parts Proportionals Printed at the end of the Table of Log. thus; if the Log. of 35786 be ſought, firſt ſeek the Log. of 3578 which will be 553649 and the common difference under D, 121; with this difference enter the Table of Parts proportional, and find 121 in the firſt Column under D, and

then lineally against that number, and under the last figure of the last place of the number 75786, found at the head in the 7th Column you will find 72, which added to the Log. of 7578, viz. 553649 makes 553721 the Log. of 75786.

Now before we proceed to find Numbers answering to Log. it will be fit to shew you what is meant by the first figure placed to the first 100 Log. which Mr. *Briggs* called a Characteristick or Index, which represent the distance of the first figure of any whole number from Unity, whose Index is a Cypher or 0; and so the Index of Tens is .1. of 100 is 2, of 1000 is 3, and as in this Line 5 4 3 2 1 0 so that CM.XMM.C.X.V. in this Number 687325 the Index of 5 is 0, of 7 is 3, of 6 is 5: But of Decimal parts it proceeds the other way; as that of ten parts is 1, of 100 parts is 2, as in this Line 3,5781, the Index of 3 is 0, of 5 is 1, of 8 is 2, of 1 is 3, or after the proposal of Mr. *Christopher Townley* take their Complements to 10; as instead of 1 take 9, of 2 take 8, of 3 take 7 which will make the Addition and Substraction more easie and plain; if the former be used let it be called the first, if the later, the second manner

	210,123458	Index the first way.
Of Indices	378,235189	Number.
	210,876542	Ind. the 2d way.

Having laid down the grounds for the Indices, or the first figure in each Log. the absolute Log. will readily be set down, making the first figure the Index of the first figure of the number; as the Log. of 5784 first the Log. in the Table, is 762228, the Index of the first figure of the number 5 is 3, so the absolute Log. is 3.762228.

N.

N.	Log.	
578,4	2.762228	So that the Log. is the
57,84	1.762228	same, but the Index of
5,784	0.762228	the first figure altereth.
,5784	3.762228	In pure parts the Log.
,05784	2.762228	is the same, but the Ind.
,005784	3.762228	altereth after the 2 way

Now to find the number answering to a Log. given, omitting the Index, seek the rest six places in the Table of Log. and where you find the summ, or neareſt the numbers in the Margent N. and over that Column will make out 4 places; The Log. 3.544821 omitting the Index 3 I find 544821 to answer 3506, and the Index shews they are all Integers, the Index shewing the first figure to be the third from Unity 6; so the Log. 1.544821, would shew 35,06, that is 35 Integers, and $\frac{06}{100}$ parts, and 3.544821. ,03506 all Decimal parts, and 1,544821 ,03506 parts. But if the Log. be not exactly to be found, and that you desire to have places to five figures, first, find the number to 4 places as before, with noting the commn difference under D on the side, and taking the difference betwixt the Log. given and the Log. found in the Table, then seeking the Common Difference in the Table of Prop. parts in that Line find out the difference of the Log. and over the head you have the fifth figure. Example of this Log. 2.543612, the Log. next less is 543571 answering to 3496, the common difference is 124, the diff. of the Log. is 41, which in the Table of prop. parts against 124 gives 3, so that the absolute number is 34963, and because the Index is 2, is 349,63.

Addition of two or more Log.

If the Indices be both (or all) Integers or whole, add them without any more.

If the Indices be some Integers, some parts, that is be unlike, if the Index upon adding, be 10 or above, cast away 10, the Remainder is the Index of Integers, if under 10 Decimal parts.

If the Indices be both Decimal parts, and if added be under 10, add 10 to the same; if just 10 then 0, if above 10 cast 10 away; the Ind. thus gotten is always of Decimal parts.

2.057821	2.237242	3.397941	3.875061
7.583210	3.875062	3.875062	1.698972
3.641031	1.698971	3.273003	1.574033
	0.811275		

Substraction of Log.

If the Indices be whole then as before.

If the Indices be either of them, or both decimal parts, set them one over another, then if the higher be a smaller figure than the lower add 10 to it, and observe whether the higher be of greater value than the lower, if so the Remainder will be Integers, if not decimal parts.

2.033421	3.875062	3.875062	2.235781
3.875062	2.033421	1.574031	3.972141
2.158359	7.841642	1.301031	7.663640

The Log. of a Fraction is found by substracting the Log. of the Denominator from the Log. of the Numerator: sometimes it is found necessary to Multiply a Log. by 2, 3, 4, &c. which if it be an Index of parts, observe that you use the former Indices, *viz.* for the first part

15 5, &c. and that in multiplying the figure next the Ind. the Tens are affirmative, and are to be deducted out of the product of the Indices of parts.

To divide a Log. of parts, if the Index be even it is ordinary, but if uneven, then add to the Ind. so many Unites till it may be divided, setting the Quot. down for a new Index, augmenting the next figure by so many times 10 as you added to the first.

5.543210	7.987214	
3	5	
5.629633	7.936070	

3) 5.321412	3) 7.232151
5.440470	7.744050

The Admirable uses of the Log. Table.

To multiply one number by any other. Add the Logarithms of the Numbers, the summ. is the Log. of the Product.

N.	Log.				
32	1.505150	5,12	0.709265	52X32=1664	
52	1.716003	1,55	0.190232	5,12 X 1,55	
1664.	3.221153	7,9360	0.899597	=7,9360.	

To divide one Number by another is to subtract the Log. of the Divisor from the Log. of the Dividend.

	N.	L.	N.	L.
Dividend	7286	3.862489	2452	3.653969
Divisor	32	1.505150	20,25	1.306211
Quotient	227,8	2.357339	14,32	2.156058

To extract the square Root of any Number is to half the Log. of that N. or divide it by 2, the Quotient Log. is the L. of the Root; and to extract the Cube Root to divide it by 3.

Number

Number 75832	----4.879852	4.879852
Divided by	2) 2.439926	3) 1.626614

Square root 275,37 Cube root is 42,327

To find a mean Proportional betwixt 2 numbers, is to add the Log. of them together, and take half;

	L	
The numbers are	9	---0.954242
	16	---1.204120
	‖Z	2.158362
The middle proportional 12.	‖½	1,079181

To find 2, 3, 4, 5, &c. mean proportionals betwixt any two numbers, take their difference and divide it by a number more by one than the number of means desired, as if 3 means divide it by 4, &c. this Log. Quotient added to the least, finds the first mean next it, and so added to the last finds the next, &c. It is desired to have 3 mean Proportionals betwixt 4 and 64, the Log. of 4 is 0.602060, of 64 1.806180; these two added makes 1.204120, the $\frac{1}{4}$ is 0.301030, which added to the Log. of 4 makes 0,903090 the Log. of 8 the first mean, and again added gives 1.204120 the Log. of 16, and again the Log. of 32 which 8. 16. 32 are the three means betwixt 4 and 64.

8. Of Reduction. Greater names are brought lower by Multiplication; as Pounds are brought to Farthings by multiplying a Pound by 20. 12. and 4, and back again by dividing by 4. 12. and 20. Ordinary Fractions are reduced into Decimals by multiplying the Numerator by 100 or a thousand, and dividing the Product by the Denominator.

Hence are all the Fractions of money, weight, time,

time, &c. turned into Decimals, as follows; Table I. of 1 l. Integer. The half of shillings is the decimal, as of 16 s. is .8, of 6 s. is .3, of 11 s. is .55, of 1 s. .05; and note in general once for all, that $\frac{1}{4}$ of any thing is .25 $\frac{1}{5}$ .5 and $\frac{3}{4}$ .75

DECIMAL TABLES.

pence	*Eng. Coyn* 1 *l. Int.* Table I.
11	.045833
10	.041666
9	.0375
8	.033333
7	.029166
6	.025.
5	.020833
4	.016666
3	.0125
2	.008333
1	.004166
f. 3	.003125
2	.002083
1	.001041

Troy weight Int. 1. oz.	
Penny weight the same with shil. Tab. II.	
gr.	
23	.047916
22	.045833
21	.04375
20	.041666
19	.039583
18	.0375
17	.035416
16	.033333
15	.03125
14	.029166
13	.027083
12	.025
11	.022916
10	.020833
9	.01875
8	.016666
7	.014583
6	.0125
5	.010416
4	.008333
3	.00625
2	.004166
1	.002083

Table III. *Averdup. great weight* 112 C. 1.	
lib.	
27	.241071
26	.232142
25	.223214
24	.214285
23	.205357
22	.196428

21	.1875
20	.178571
19	.169642
18	.160714
17	.151785
16	.142857
15	.133928
14	.125
13	.116071
12	.107142
11	.098214
10	.089285
9	.080357
8	.071428
7	.0625
6	.053571
5	.044642
4	.035714
3	.026785
2	.017857
1	.008928
oun.	
15	.008370
14	.007812
13	.007254
12	.006696
11	.006138
10	.005580
9	.005022
8	.004464
7	.003906
6	.003348
5	.002790
4	.002232
3	.001674
2	.001116
1	.000558

quart.	
3	.000418
2	.000279
1	.000139

Table IV. *Averd. little weight Int.* 1 l.

oun.	
15	.9375
14	.875
13	.8125
12	.75
11	.6875
10	.625
9	.5625
8	.5
7	.4375
6	.375
5	.3125
4	.25
3	.1875
2	.125
1	.0625
dr.	
15	.058593
14	.054687
13	.050781
12	.046875
11	.042968
10	.039062
9	.035156
8	.03125
7	.027343
6	.023437
5	.019531
4	.015625
3	.011718
2	.007812
1	.003906

quarter	
3	.002929
2	.001953
1	.000976

Table V. *Measure Gallon or Quar. the Int.*

7	.875
6	.75
5	.625
4	.5
3	.375
2	.25
1	.125

quarter	
3	.09375
2	.0625
1	.03125

Table VI. *Inches in Dec. of a Foot.*

inches	
11	.916666
10	.833333
9	.75
8	.666666
7	.583333
6	.5
5	.416666
4	.333333
3	.25
2	.166666
1	.083333

quart.	
3	.0625
2	.041666
1	.020833
$\frac{1}{3}$ quar.	.010416

Table VII. *Decimals of a year.*

Months	
1	.083334
2	.166667
3	.25
6	.50
9	.75

Dayes	
1	.0027397
2	.0054795
3	.0082193
4	.0109591
5	.0136988
6	.0164386
7	.0191784
8	.0219182
9	.0246579

The uſes of the Decimal Tables.

Any parts of money, weight or meaſure given, you may turn into Decimals or *contra*. 3 l. 15 s. 7 d. $\frac{1}{2}$ = 3,78124, for 15 s. = ,75. 7 d. = ,029166, and $\frac{1}{2}$,00208, in all 3 l. ,78124. Again,

gain, 16 C. $\frac{3}{4}$ 17 l. Averd. weight = 16,90178.

If Decimals be to be turned into their natures again, as 37 l. ,5692, first 37 l. is the Integer, then 55 of the first 2 figures will be 11 s. and the remainder ,0192 will be 5 d. $\frac{1}{2}$.

9. A short Specimen of Fractions for the better remembring the Rules of

(1.) of the great. Common measure || Ex. of $\frac{36}{54}$ 36) 54 (1 / 36 / 18) 36 (2 C.M. 18) 36 (54 (

(2) Reduction 6) $\frac{15.}{5}$ $\frac{14}{7}$ / 12 18 / 3. 2 / 36 are $\frac{15}{36}$ and $\frac{14}{36}$

3. Fractions of fractions $\frac{1}{4}$ of $\frac{2}{4}$ of $\frac{6}{7}$ $= \frac{12}{84}$ (12 / 84)

4. Addition & substract. of fractions reduced || $\frac{15}{36} \pm \frac{14}{36} = \frac{29}{36}$ & $\frac{1}{36}$

5. Multiplicat. $\frac{2}{3} \times \frac{4}{5} = \frac{8}{15}$ (6) Divis. $\frac{4}{5}$) $\frac{2}{3}$ ($\frac{10}{12}$

10. Of Progressions and Combinations.

1. Geometrical progression that begins with Unity, you may come at any term of it by multiplying the Log. of the second term by the number of so many places, as the distance requires less, 1. Ex. in a progression that is double, having 1. and the second term 2, and you desire the 8 term, multiply the Log. of 2 by 7, it gives you 2,10721, the Log. of 128, the 8th term,

term, and this holds if the first term be not Unity, if you take the Log. of the Ratio.

2. Combination of things may differ many wayes; Two only are here considered: (1.) In the changing their position, as in ringing of bells, the other in the matter or substance; for the first set down a series of numbers from Unity, multiply 1 by 2 shews 2 things can be changed twice: again $2 \times 3 = 6$ shews three things may change 6 times, 4 may change 24, and 5 120.

As						
1,	2,	3,	4,	5,	6,	
2.	6.	24.	120.	720.		

For the second, suppose *a b c* be essentially different a Ternary; There are three Unites, *a*, *b*, *c*. three Binaries, *ab*, *bc*, *ac*, and one ternary *abc*. and so many Combinations there may be and no more.

Now to find out the Combinations it is easily done by the posterior Table in Mr. *Oughtreds Clavis Math.* p. (37) he calls it *(plena hæc misteriis pulcherrimis Talula)* I say the numbers set by the Species shew the Combinations desired, only one of the Extream Unites must be left out, and the obtaining those numbers is thus; set down Unity, then repeat two Unites and leave one space, and then 2 spaces, 3, 4, *&c.* the Intermediate are filled by adding the numbers on either side standing above, as to make up the lowest row $1 + 4 = 5$ standing next above on either side, $4 + 6 = 10$, *&c.* then leaving out the Unites on the right hand:

	1
	1. 2. 1.
	1. 3. 3. 1.
	1. 4. 6. 4. 1.
	1. 5. 10. 10. 5. 1.
	&c.

1	1	$= 1$
2	$2 + 1$	$= 3$
3	$3 + 3 + 1$	$= 7$
4	$4 + 6 + 4 + 1$	$= 15$
5	$5 + 10 + 10 + 5 + 1$	$= 31.$
&c.		

so that if the matter be 3, there may be 3 Unites, 3

Binaries, and 1 Ternary, in all 7 Combinations.

If the matter be 4, there may be 4 Unites, 6 Binaries, 4 Ternary, and 1 Quaternary, 15 = &c.

11. *Of Proportion.* Direct is when more requires more, and leſs leſs: This is called the *Golden Rule*, when 3 numbers are given to find a fourth, and requires that the ſecond and third terms be multiplied together, and the firſt divide that Product, the Quotient ſhews the anſwer: Ex. If 5 yards of any thing coſt 15 s. what ſhall 45 yards coſt? An. 61. 15 s. for ſetting them down thus; 5. 15 :: 45. 45 X 15 = 675 and 5) 675 (135 = 6 l. 15 s.

The Back Rule requires the firſt and ſecond to be multiplied, and that the third divide that Product. And this Rule is known, becauſe that more will require leſs, or leſs more. Ex. If 4 horſes eat 5 pecks of oats in 3 dayes, 8 horſes will eat 5 pecks in a leſſer time.

The Double Golden Rule, or Rule of 5 Numbers is of great uſe in many reſpects, and therefore as it is eaſily explained in *Mooros Arith.* take it from thence: Let that which is the principal cauſe of loſs or gain, intereſt, action, &c. be put in the firſt place; that which betokeneth Time, diſtance of place, &c. be in the ſecond place, and the remaining in the third; under this Conditional part place the two other terms each under his like; and there will be a blank to ſupply under one of thoſe above, either under the firſt, ſecond or third. Ex. If one hundred pound in 12 months gain 6 l. (this is the Conditional part) what ſhall 50 l. get in 3 monthes, place them down as in the Rule; and here the blank is under the third term, but if the demand had been, in how many monthes would 50 l. have gained 15 s. or if 100, in 12 months

lib.	m.	
100.	12.	6 l.
50.	3.	

12 months gain 6 l. what ſhall the principal be, that in 3 months would gain 15 s.; in theſe two laſt caſes the blank would have been under the firſt or ſecond terms, there are but theſe Caſes; Rule 1. if the blank be under the third term, multiply the three laſt for a Dividend, and the two firſt for a Diviſor, the Quotient of theſe gives the ſixth; 6X50X3= 900 and 100X12= 1200: now 1200) 900,0 (,75 = 15 s. But if the blank fall under the firſt or ſecond term then the rule will be; Multiply the firſt, ſecond and laſt for a Dividend, and the third and fourth for a Diviſor, the Quotient is an Anſwer: This Rule ſhews ſimple Intereſt, and all belongs to it with eaſe, and was thus found. Set with Mr. *Mern*, P. T. G. for the principal Time, and Gaine in the Conditions, and p. t. g. anſwering, it will be P. G. :: p. $\frac{Gp}{P}$ and T. $\frac{Gp}{P}$ :: t. $\frac{Gpt}{TP}$ = g. So that multiplying the 3 laſt for Dividend, and 2 firſt for Diviſor is the firſt Rule, and becauſe $\frac{Gpt}{TP}$ = g. it will be Gpt = TPg therefore t = $\frac{TPg}{pG}$ and p = $\frac{TPg}{Gt}$. which is the ſecond Rule.

12. To any two Numbers, to find a third in continual proportion, Rule. Square the ſecond and divide it by the firſt.

CHAP. IV.

Rules of Practice, IN ARITHMETICK,

For Interest, plain and spherical Triangles, Measuring of Plains, Solids, Circles and Spheres, Gaging, Fortification, Gunnery, Astronomy, Dyalling, making of Watches and Movements, Geography, Navigation.

§. 1. RUles of Practice in Arithmetick, first learn to half a number from the left to the right speedily; As for *Ex.* 8431076, the half is 4215538, beginning with 8 take 4, of 4 take 2, these are even and easie; but for 3 I take 1, and carry 10 to the next, which is 11, I take 5 remains 10, then for the 0, I take 10 and set down 5, for 7, 3 and for 16, 8. This brings shillings into pounds by cutting off the last figure, and taking the half of the rest; thus 784|6 s. make 392 l. 6 s. *&c.*

2. Because that 12 pence make a shilling, it will be well to be expert in Multiplying or Dividing by 12: A small paper of duodecimal Arith. was 11 years since drawn up at the desire of Sir *Rob. Long*, and it seems admirable with what ease and fewness of figures, that Arithmetick will work all measures by foot and inches, and 12 parts for the inch, and for shillings and pence, and 12 parts of a penny: Here must two figures or digits be added, *viz.* x for 10, and

10, and n for eleven, the Account will be Unites, Dozens, Groſſes, &c. and the parts will diminiſh accordingly: But here is not room to explain it, take an Example: A piece of black Marble 2 feet 9 inches and $\frac{1}{2}$ broad; 3 f. 2 inc. $\frac{1}{4}$ deep and 8 foot 3 inch. long, how many feet? and what rate at 1 s. 3 d. $\frac{1}{2}$ *per* foot.

In the firſt operation, the ſolidity of the whole Marble is 6 dozen, and one foot, or 73 ſolid feet and a $\frac{1}{3}$ and by the ſecond operation, the price will be 7 dozen and ten ſhillings, that is 94 ſhillings 8 d. $\frac{3}{4}$.

(1) *Op.* 2:96 (2 *op.*)
2:23
8.46 61,4
570 13 6
846 3080
8:x946 1640
8:3 614
2284
5n22 7x: 880
61:4x4 = 94 s. 8 d $\frac{3}{4}$

3. The Aliquot or even parts of ſhillings and pounds are to be learnt, as 1 d. $\frac{1}{2}$ is the $\frac{1}{8}$ part, 1 d. the 12th part, 2 d. the ſixth part, 3 d. the $\frac{1}{4}$ part, 4 d. the $\frac{1}{3}$ part, 6 d. the half of a ſhilling; 1 s. the 20th part, 2 s. the tenth, 4 s. the 5th part, 5 s. the 4th part, 3 s. 4 d. the 6th part, 6 s. 8 d. the third part, and 10 s. the half of a pound; knowing theſe the price of any one thing will be known, if 1 l. or 1 Integer of that thing be known. At 6 d. the ounce, what comes 372 ounces, becauſe 6 d. is the $\frac{1}{40}$ of a ſhilling; take half of 372 = 186 ſhillings: The practice you have in every Book of Arith. Likewiſe you may obſerve the even parts of other things; ſuppoſe the great hundred 112 l. the half is 56, the quarter 28, the eighth part is 14, the 16th part 7; ſo that at 54 s. the C. what comes 15 C.

3 quar. and 18 pounds, the whole hundreds comes to 40 l. 10 s. the $\frac{3}{4}$ is three fourths of 54 s. which is 40 s. and 6 d. Laſtly, for the 18 l. find what 14 l. comes to, *viz.* 6 s. 9 d. and 4 l. to 1 s. 11 d. in all 42 l. 19 s. 2 d.

3. The hundred weight whether neat, or the great C. which is 112 l. it will be worth while to give you the price of either at any ſmall rate the pound weight; Ex. at 3 d. $\frac{1}{2}$ the pound, what comes either C. to: put the price of a pound into farthings, *viz.* 14; for the Neat C. account twice ſo many ſhillings, and as many pence as farthings; and for the great C. twice ſo many ſhillings, and as many Groats as there be farthings in the pound weight. Ex. 14 s. and 14 s. make 28 s. and 14 d. makes 29 s. 2 d. the Neat C. and 14 s. twice, and 14 groats makes 32 s. and 8 d. for the great C. So daily expences are for every penny ſpent a day, one pound, one half pound, one groat, and one penny: 5 d. a day is after that rate 7 l. 12 s. 1d. There is conſtant uſe made of the great hundred, therefore I have annexed a Table, which in the firſt Column contains the price of one pound from 1 farthing to 2 s. and in the ſecond you have the price of the C. weight; the greater figures are pence, the leſſer farthings. If the price exceed the Table, take half, or $\frac{1}{4}$ of it, and double or redouble the price; and ſo ſeeking in the Table for the price of a C. weight, you have the price of a pound or unite anſwering.

A Table

A Table for buying and selling by the C. weight.

l. p.	C. pr. l. s. d.	l. p.	C. pr. l. s. d.	l. p.	C. pr. l. s. d.	l. p.	C. pr. l. s. d.
1	0. 2. 4	6. 1	2. 18. 4	1	5. 14. 4	1	8. 10. 4
2	0. 4. 8	2	3. 0. 8	2	5. 16. 8	2	8. 12. 8
3	0. 7. 0	3	3. 3. 0	3	5. 19. 0	3	8. 15. 0
1	0. 9. 4	7	3. 5. 4	13	6. 1. 4	19	8. 17. 4
1	0. 11. 8	1	3. 7. 8	1	6. 3. 8	1	8. 19. 8
2	0. 14. 0	2	3. 10. 0	2	6. 6. 0	2	9. 2. 0
3	0. 16. 4	3	3. 12. 4	3	6. 8. 4	3	9. 4. 4
2	0. 18. 8	8	3. 14. 8	14	6. 10. 8	20	9. 6. 8
1	1. 1. 0	1	3. 17. 0	1	6. 13. 0	1	9. 9. 0
2	1. 3. 4	2	3. 19. 4	2	6. 15. 4	2	9. 11. 4
3	1. 5. 8	3	4. 1. 8	3	6. 17. 8	3	9. 13. 8
3	1. 8. 0	9	4. 4. 0	15	7. 0. 0	21	9. 16. 0
1	1. 10. 4	1	4. 6. 4	1	7. 2. 4	1	9. 18. 4
2	1. 12. 8	2	4. 8. 8	2	7. 4. 8	2	10. 0. 8
3	1. 15. 0	3	4. 11. 0	3	7. 7. 0	3	10. 3. 0
4	1. 17. 4	10	4. 13. 4	16	7. 9. 4	22	10. 5. 4
1	1. 19. 8	1	4. 15. 8	1	7. 11. 8	1	10. 7. 8
2	2. 2. 0	2	4. 18. 0	2	7. 14. 0	2	10. 10. 0
3	2. 4. 4	3	5. 0. 4	3	7. 16. 4	3	10. 12. 4
5	2. 6. 8	11	5. 2. 8	17	7. 18. 8	23	10. 14. 8
1	2. 9. 0	1	5. 5. 0	1	8. 1. 0	1	10. 17. 0
2	2. 11. 4	2	5. 7. 4	2	8. 3. 4	2	10. 19. 4
3	2. 13. 8	3	5. 9. 8	3	8. 5. 8	3	10. 1. 8
6	2. 16. 0	12	5. 12. 0	18	8. 8. 0	24	10. 4. 0

Tuns are brought to Hundreds by X by 20.

4. The last Note shall be, that in weighing of goods, the weights 1 l. 3 l. and 9 l. will weigh all from 1 l. to 13. 1 l. 3 l. 9 l. 27 l. all

all from 1 to 40. 1l. 3l. 9l. 27l. 81l. all from 1 to 121, *&c.*

At the later end of the Book you have a Table for the ſumming up of Commodities, the uſe is plain by Inſpection only.

(§ 2.) Rules of Practice for caſting up of Intereſt money, whether Simple or Compound, rebates and values of Leaſes.

1. Note is of ſimple Intereſt, of uſe amongſt Merchants, you muſt know readily to caſt up the dayes betwixt any two named times: In one year $365\frac{1}{4}$, in two years $730\frac{1}{2}$ in three years, $1095\frac{3}{4}$ and likewiſe by this Table to find the dayes; Ex. 1. From the beginning of the year to the 11th of *Oct. Oct.* has 273 dayes, and 11 makes 284. Ex. 2. From 12th of *March* to the 16 of *December*, ſubſtract *Mar.* 59 + 12 = 71 from *Dec.* 334 + 16 = 350 reſts 279 dayes. Ex. 3. From 10th of *Jun.* 1673 to the 5th of *Feb.* 1674. Say 20 + 184 + 31 + 5 = 240 dayes. The Intereſt for one day of one pound at 5 pound *per Centum* is this Decimal ,00013698 36, at 6 l. *per Cent.* ,000164384, which are gotten by dividing 5 and 6 by 36500; and ſo of any other: Now to find the Intereſt of any ſumm of money for certain dayes, firſt find the Intereſt of one pound for that time, by multiplying ,000164384 for *6 per Cent.* by the dayes; and then that product by the ſumm of money.

334	*Jan.*	00
306	*Feb.*	31
275	*March*	59
245	*Apr.*	90
214	*May*	120
184	*June*	151
153	*July*	181
122	*Aug.*	212
92	*Sept.*	243
61	*Octob.*	273
31	*Nov.*	304
00	*Dec.*	334

money gives your desire; or easily if you add the Logarithm of ƀ.21586217 for 6 *per Cent.* or ƀ.13666528 for 5 *per Cent.* to the Log. of dayes, and the Log. of the summ of money proposed together, it gives you the Log. of the Intereſt; and to rebate or to know the present worth of any summ due hereafter, you must find the Intereſt of 1 l. for that time adding 1 Integer to it, and divide the summ propounded by it, the Quot. is the present worth. Here follows a Table of simple Intereſt of 1 l. for any dayes under 10000 at 6 *per Cent.*

D.	M			C		X	
	lib.	s.	d.	s.	d.	d.	par.
1		3:	3.452		3.945	.394	,039
2		6:	6.904		7.890	.789	.079
3		9:	10.356		11.835	1.183	.118
4		13:	1.808	1:	3.780	1.578	.157
5		16:	5.260	1:	7.726	1.972	.191
6		19:	8.712	1:	11.671	2.367	.236
7	1:	3:	0.164	2:	3.616	2.761	.276
8	1:	6:	3.616	2:	7.561	3.156	316
9	1:	9:	7.068	2:	11.506	3.550	.355

The use of this Table is easie; the first Column are dayes, and if used with the second Column are thousands; if with the third are hundreds; if the fourth are tens, and the fifth are single Unites. Ex. What is the use of 1 l. or 1732 dayes. An. 5 s. 8 d. $\frac{1}{4}$ for ,25 = 1 f. 50 = 2 f. 75 = 3 l. and if you turn the Intereſt of one pound found as before into decimals, and multiply it by the summ propounded in decimals, it gives the Intereſt of that summ. And for equation of payments, or giving of time

	l.	s.	d.
1000	0	3	3.452
700		2	3.616
30			1.183
2			.079
	5	8	330

time, as at 2 three Months, or at 3 six Months, &c. or Weeks, Years or Dayes, or the like; suppose three, 3 months, multiply the terms 3 and 3 makes 9, add the later 3 makes 12, the half whereof is the equated time, *viz.* 6 months. So the equation for 4 six months is 15, *viz.* $4 \times 6 = 24 \div 6 = 30$---- $\frac{1}{2}$ 30 is 15. To conclude this Note of simple Interest practise the double Gol. Rule taught before, it answers all questions whether of the principal, time, or gain.

2. Of compound Interest, or Interest upon Interest. The Logarithms answer Questions of this nature with great ease; and first if the Interest be at *6 per Cent.* find the Log. of 106, divide it by 2 for $\frac{1}{2}$ Years, by 4 for Quarters, by 12 for Months, and by 365 for Dayes, and keep these Log. for Use.

Log. of 1,06	0.025306
$\frac{1}{2}$ Year	0.012653
$\frac{1}{4}$ Year	0.006326
Month	0.002109
Week	0.000527
Day	0.000075

You have six Questions in *Moores Arith.* wrought at large, the following Examp. will make all plain for 1 l. *viz.* Mr. *Oughtreds* six *Theorems* after 6 *per Cent. viz.* A, B, C, D, E, F.

The. 1. P lends to R 1 l. for 3 years, what must P receive at the end of the term? A.

The. 2. P hath owing from R 1 l. at the end of three years, and would know the worth in ready money? B.

	Yearly.
1,06----	0.025306
	3
A 1,1910	0.075918
B ,83962	5.924081 Ar.Co.

So that A answers the first Question; that is, P must receive 1 l. and ,191 of a l. that is, 3 s. and 10 d. And B. the

B. the second, that is, 16 s. 9 d. ob. A is gotten by multiplying the Log. of 1,06 by 3; and B is the Arithmetical Complement of A.

The. 3. P hath an Anuity of 1 l. *per An.* and R forbears payment to the end of three years, what will it amount to? C.

The. 4. R is to pay 1 l. at the end of three years unto P, and would know what rent is to be paid yearly for that debt? D.

First, A-1 is 1,191--1 =,191, and 1,06-1=,06 After Substraction it leaves the Log. 6 of C 3 l. 3 s. 8 d. and the Arithm. Complement is D. 6 s. 3 d. $\frac{1}{2}$.

A--1=,191 ȝ.281033
1,06-1=,06 ȝ.778151
C 3,1833 0. 502882
D ,31413 ȝ. 497117 Ar. Com.

The. 5. P has an Anuity of 1 l. *per an.* for three years, and would know the present worth in ready money.

The. 6. P hath 1 l. to bestow of an Anuity for three years, and would know the yearly Anuity.

The Answer to the 5*th The.* is E 2 l. 13 s. 5 d. $\frac{1}{2}$ and the 6*th* F 7 s. 6 d. Thus for 1 l. the Answers are fitted to all the 6 Questions, and the same is to be perform'd after the like manner, if the payments were half yearly, quarterly, *&c.* taking the Log. answering as before. And after you have found your Answer for 1 l. by adding its Log. to the Log. of any other summ, it gives your desire. Ex. If 352 l. 10 s. were due 3 years hence, and I desire to know what it is worth to pay presently; I add the Log. of 352,5--2.547159 to the Log.

C 3,1833 0.502882
A 1,191 0.075918
E 2,6728 0.426964
F ,37414 ȝ.573036 Ar. C.

B 2,924081 found as before makes 2.471240, which is the Log. of 295,97, or 295 l. 19 s. 6d. the Anſwer.

Rules concerning Free-holds to be bought and ſold.

The Anual Rent, divided by the bare Rate of Intereſt propoſed, produceth the ſumm of ready money that Free-hold Eſtate is worth. Exam. 300 l. *per an.* after the rate of 6 *per Cent.* is worth 5000 l. ,06) 300,00 (5000.

And if the Rent be $\frac{1}{2}$ yearly or quarterly, divide by ,0296 and ,014674.

Any ſumm of money (1000 l.) lying ready for a Purchaſe being multiplyed by the bare rate of Intereſt, (,06) produceth, the yearly Rent. 1000x,06= 60,00 or 60 l. *per annum.*

The Annual Rent (60 l.) being divided by a ſumm propounded (1000 l.) quotes the bare Intereſt of 1 l. 1000) 60,00 (,06.

Divide Unity (1) by the bare rate (,06) of 1 l. the Quotient gives the number of years purchaſed. ,06) 1.00 (16,6 5) 1,00 (20. 8) 1,00 (12.

If the Rents be $\frac{1}{2}$ yearly or quarterly paid, work as you were formerly directed.

Here

Here follows a Table to purchase by, at 5, 6, 8 and 10, *per Cent.* Interest.

Y.	5 *p. C.*	6 *p. C.*	8 *p. C.*	10. *C.*	Y.	5 *p. C.*	6 *p. C.*	8 *p. C.*	10. *C.*
1	0 10	0 10	0 11	0 11	19	12 1	11 2	9 10	8 11
2	1 11	1 11	1 9	1 9	21	12 10	11 11	9 10	8 11
3	2 9	2 8	2 7	2 6	23	13 6	12 4	10 4	8 9
4	3 7	3 6	3 4	3 2	25	14 1	12 9	10 8	8 9
5	4 4	4 3	4 0	3 9	27	14 8	13 3	10 11	9 3
6	5 1	4 11	4 8	4 5	29	15 2	13 7	11 2	9 6
7	5 9	5 7	5 4	5 1	31	15 9	13 11	11 5	9 6
8	6 6	6 4	6 1	5 9	41	17 7	15 1	11 11	9 11
9	7 3	7 0	6 9	6 5	51	18 3	15 9	12 3	9 11
10	8 0	7 9	7 5	7 1	61	19 0	16 5	12 8	10 0
11	8 8	8 5	8 2	7 9	71	19 7	16 12	12 12	10 0
13	9 10	9 7	9 3	8 10	81	19 19	16 16	12 16	10 0
15	10 5	9 9	9 6	8 11	91	19 19	16 16	12 16	10 0
17	11 3	10 7	10 2	9 6					

The first Column is of Years, the second is the time to Purchase; the first figure being Years, the second Months. A Rent to endure 7 years, is worth ready money after 5 l. *per Cent.* 5 years and 9 months; the third Column is at 6 l. *per Cent.* the fourth at 8, and the fifth at 10 l. 5 l. *per Cent.* is at 20 years Purchase, 6 l. at 16 years and 8 months; 8 l. *per Cent.* at 12 years and a half; 10 l. *per Cent.* at 10 years: So that 5 l. and 6 l. *per Cent.* may be used for Free-hold Estates, and the 8 l. or 10 l. for Houses.

§. 3. Of plain and Spherical Triangles.

Inſtead of Chords, the Sines and Tangents were invented, and brought to a Decimal Radius, and it might be wiſhed that the Sexagenary Account be left off, and the Centeſimal taken.

After the Logarithms you have a Table of Artificial Sines and Tangents to every degree and ten minutes, which will do well enough for ordinary Mechanical Works, and with a ſmall labour you may ſupply the ſame to minutes.

The Sine or Tangent of any degree, and ten minutes, if they be under 45 deg. are found by looking in the Column on the left ſide, the Degrees are in greater figures, and if above 45 deg. by looking in the Column, on the right ſide, accounting from the bottom towards the top. *Examp.* The Sine of 13°. 30′ will be found 9.368185; the Tangent 9.380354; the Sine of 67, 20 will be found 9.965090: the Tang. 10.379213: The Complement of any degree and minute being the Remainder of the ſame to 90°, anſwers in the ſame line in the two outmoſt Columns; as to 22° 10′ anſwers 67° 50′, and ſo doth the Sines and Tangents, for the Sine of 22°. 10′ being 9.576689, the Sine 9.966653 being its Complement or Coſine of 67°. 50′ ſtands next; and ſo of the Tangents.

If you deſire the Sine of 22°. 24′ ſeek the Sine of 22°. 20′ which is 9.579777, take the difference betwixt this and the next increaſing, which is 3063, then ſay if 10. 3063 :: 4. 1225. add this to the former Log. it makes 9.581002, which is the Log. of 22°. 24′: you may work this by the Log.

Now to find the degree and minute anſwering to any Log. given; ſuppoſe the Sine 9.457584, I ſeek this in the Table and find it anſwers

16°.

16°. 40′ and to this Tangent 10.475480, 71°. 30′, and if you ſeek for every minute, you muſt take the difference of thoſe two Log. betwixt which yours fall, and the difference betwixt yours and the leſſer, then ſay, as the Tabular Diff. is to the other difference : : ſo is 10 to minutes ſought. *Ex.* The Sine 9.500163 being given, the next leſs in the Table 9.497682, the difference 2481. The Tabular diff. 3794, then ſay, if 3794. 10 : : 2481. it will give 6′; ſo the correſpondent degree and minute will be 18°. 26′. This being learnt, we come to the Doctrine of plain Triangles, but firſt know theſe Characters; ∠ an Angle; r.∠, a right Angle; l. a ſide; Hyp. the Hypothenuſe; Ba. Baſe; Ca. Cathetus; Δ. Triangle; Dat. Given; S. Sine; T. Tangent; Cof. Coſine; Cot. Cotangs.

1. Of plain Δs, let every r.angled Δ be noted with three Letters; A, B, C; let A be the r.∠, BA the Baſe, CA the Cathetus or Perpen. and BC the Hypothenuſe, and all Oblique Δs with B C D, let B D be the Baſe: then obſerve theſe *Propoſitions*. (r.∠) (F. 1.) (F. 2.)

Prop. I. The Sides, and Sines of the oppoſite Angles are proportional, and in any Triangle where two Sides, and one Angle oppoſite are given, and it be required to find the Angle oppoſite to the other Side: As l: . S: ∠ Opp : : l: S: ∠ required: Or if two Angles, and the Side oppoſite, the one be given, to find the l: oppoſite to the other; Say, As S: ∠. l: opp : : S: ∠. l: required; this reacheth generally to all Δs. Note that in a r.∠Δ if one acute Angle be known, the other is known, becauſe it is the Complement to 90°. and in an Oblique Δ if two Angles be known, the third is given, becauſe the Complement to 180°.

Prop. II. In r.∠Δs. As one Side. to the o-

(F. 1.) ther : : ſo is Rad. to the Tang. of an ∠ oppoſite the other, B A. C A : : Rad. t. ∠ B.

Prop. III. In every plane Δ. As, the ſumm of the two Sides. is to their Difference : : So is the Tangent of half the ſumm of the two oppoſite Angles. to half their Difference; therefore if two Sides and the Angle included be given, the reſt will be known.

Prop. IV. As the greater Side. to the ſumm of the reſt : : ſo is the Diff. of thoſe two remaining Sides. to the difference of the ſegments of the Baſe, the Perpendicular will fall in the middle of the Remainder.

Theſe four *Prop.* will reſolve all plain Δ^s.

Rad. 90°. --	10.000000
B C 1277 --	3.106191
S. ∠ B. 28. 20' -	9.676328
C A. 606. --	2:782519

Ex. In the Δ B A C 1^st ∠ at A. Let the Hypothenuſe B C be given, and ∠ B to find the Side C A. By the *I. Prop.*

Rad. 90°. --	10.000000
B A. 1124 --	3.050766
t: ∠ B. 28. 20'	9.731746
C A. 606. --	2.782512

Having B A the diſtance from any place to the foot, 1124 feet or yards, and ∠ B. 28. 20, to find the height C A. 606 feet or yards:

By *Prop. II. Fig.* (3.)

In the Oblique ∠ Δ D B C, *Fig.* (3.) having ∠ C D B 43°. 20', and the ∠ C B A. 58°. ∠ D B C will be 122, and the ∠ D C B 14°. 40', the firſt two ∠^s are had by obſervation, the other Complements, by the *I. Prop.* you may have D C 335, and B C 271, which are the diſtances

distances from D and B to C, though you came no nearer than D. Likewise in the rt ∠ Δ B C A, supposing C A some height unapproachable, after the Angles at D and B be taken, and the distance B C = 71, as before; you may find by the *I. Ex.* C A 230 feet, yards, &c. the height, and B A the distance 143,7; and by these two last *Exam.* all heights and distances whether accessible or no are taken.

S: B. 140. 40′	9.403455
D B. --- 110	2.000000
S: C. --43. 20	9.826477
I: B C --- 271	2.432022
S: D B C. 580.	9.928420
I: D C. -- 335	2.529965

2. Of Spherical Triangles, and first of rt ∠ Δs. In these there are 5 parts, besides the rt ∠, (which is no part) to be considered; in the Δ A B C. (*Fig.* 4.) A is the rt ∠. the Sides B A and C A are taken simply, which make two parts, the ∠ C and B, and the Side B C by their Complements which make three parts, five in all: Three of these alwayes fall into the Question, whereof two are given and one demanded, and these three in the Question either fall all together, as B. B A. A C. or B A. A C and C, or A C. C. B C or B C. B and B A. or C. B C and B, in all which five cases B A. A C. C. B and B C are the means, and the other two the extreams, or a sunder and disjunct; as, B A: B C and C: B C. B A: C A: C. B and B A, wherein B A, B C and C which are separated from the other two, are called the Intermedia's, the other the Opposites:

A. 1. As Tan. of one Extreme. To the Sine of the Mean :: So is Rad. to Tang. of the other.

A. 2. As si. co. of the one Opposite; to sine of the Intermedial :: so Rad. to the Cosine of the other.

By these 2 *Ax.* and the former observations, any part of a r^t ∠ Δ may be gotten by knowing two parts : *Ex.* In the Δ B A C. where let B represent the Equinoctial point, and the Angle of the greatest Dec. 23°. 30', and B C a part of the Ecliptick 34. 20. I demand C A the Dec. Here B and B C are given C A demanded. C A is disjoyn'd and B, B C are the opposites ; therefore by the second *Ax.* As R. Cosy. B C :: Sico. B. Sine of C A, but you are bid to take the Complements of B and B C, therefore as in the work R. Si. B C :: Si. B. Sine C A ; this is plain and sufficient for r^t ∠ Δ^s.

As, Rad. ---	10.000000
Si. B C 34. 20 -	9.751284
Si. B. 23. 30' -	9.600700
Si. C A. 13°. -	9.351984

Of oblique Spherical Triangles the parts are six, 3 sides and 3 Angles, whereof 3 are given, and 1, 2 or 3 may be sought ; four of these six are called Ingredients, whereof 3 must be given and one sought : And of these four there may be three several Divisions ; first, they may be opposed one to another, as l. to ∠ and l: to ∠ or contrarily, and then S: ∠. S: l. :: S ∠. S. l. or S: l. S: ∠ :: S. l. S. ∠. Secondly, they all follow together ; or thirdly, three together and one removed : In the two latter the part sought may be found at two Operations and no more, by letting fall a Perpendicular, which must always fall from or upon one of the Ingredients, and never from or upon two. For the Calculation of any of these observe the Rules following :

I. The Perpendicular being let down, the two Ingredients left intire annexed and given, must be marked with the letters, B and B C the ∠ and Side given.

II. One

II. One of these two, either B or B C must begin the Account of the four Ingredients in the Question, and the Perpendicular must alwayes fall upon B D extended if need be.

III. If the ∠s at B and D be both acute, then the Perpendicular will fall within the Δ, and then D A ⊐ B D -- B A and ∠ D C A ⊐ ∠ B C D -- B C A, as in the 5 *Figure* : But if the one of B or D be obtuse and the other acute, then will it fall without, as you may perceive in the 5, 6, and 7 *Figures* : Then D A ⊐ B A + B D and ∠ D C A ⊐ B C D + B C A, as in the *6th Fig.* or D A ⊐ B A -- B D and D C A ⊐ B C A -- B C D, as in the *7th Figure.*

IV. The order being begun as before, either at B or B C either all four will follow one another, or else three of them, and the fourth removed from the rest.

V. After the Perpendicular be let fall, the Sides B A, A D, or the ∠s B C A, or A C D, or A C B are found out, as in rt angled Triangles.

After D A and B A, or ∠ B C A, or A C D be found as before, the Triangles are found and performed by two *Cases*, and each *Case* two Problems.

Case I. Where all four Ingredients follow each other.

1. *Prob.* Leader B C thus, B C. B B D. D and either B D, or D sought, as syne D A. S. B A : : t B. t D.

2. *Prob.* Leader B thus B. B C. B C D. DC. and either B C D, or B C is sought ; say, cosy. D C A. cosy. B C A : : t. B C. t D C.

Case II. Where three follow immediately and one separated.

1. *Prob.* Leader B C. thus B C. C. C D and B D, and either D C or B D are sought ; say, Cosy: B A. Cosy: D A : : Cosy: B C. Cosy: DC.

2. *Prob.*

2. *Prob.* Leader B, thus B. B C. B C D and D, and either D or B C D are required; ſay, ſi: B C A. S: D C A :: Coſy: B. coſy: D.

Laſtly, in the two *Caſes*, firſt where three Sides are given to find an Angle: For *Ex. Fig.* 8:*b*, In the Triangle B C D, let all the Sides be given, *viz.* B C 38. 30. C D 70, and B D 60, and let the Angle C be ſought: Firſt, ſet down the Arith. Comp. of the Sines of B C and C D including the ∠ ſought. Take the Difference of theſe ſides, and under that Diff. ſet down the third ſide, take their ſum and difference and ſet down their Sines; laſtly, ſum up all four Sines, the half ſum will find out an Arch among the Sines, which being doubl'd will be the ∠.

		Si.
B C 38. 30	Arith. Co:	0.205850
C D 70. 00	Arith. Co:	0.027014
31--30	Diff.	
B D 60. 00	third ſide	
Z. 91. 30		
X. 28. 30		
half Z. 45. 45.	Si:	9.855096
half X. 14. 15.	Si:	9.391205
	Sum——	19.479165
	half ſum——	9.239582
Sine of 10°. doubled 20	= ∠ C.	

And if three Angles be given to find a ſide, if inſtead of the greateſt ∠ you tak its Complement to 180, the Angles will be ſides and ſides ∠s, as in the laſt.

§. 4. Of Longimetry, Planometry and Stereometry.

Note 1. The meaſures uſed for lengths, as you had them in the CHAP. II. are either Inches divided into ten parts, Feet divided into 100 parts, or 12 inches, a Gad or Rod divided into ten feet, and a Perch or Pole divided into 100 links, containing $16\frac{1}{2}$ feet, or 18 feet; theſe or

any

any of these may be used as occasion requires.

2. Care must be had, that in measuring any Line or length whatsoever, you deviate not from a streight Line, therefore set up small pikets betwixt you and the Mark that may direct the Line, or if you measure by a four pole chain, then the hindermost man look that the Leader go streight, or cover the Mark. If a Line decline, and you would know the Horizontal Line in going down a precipice at the end of the Gad or Rod held Horizontally, let fall a small stone or any small weight that will shew the point where you must hold Horizontally again.

3. To level a length or line, or to know what difference of height in rising or falling betwixt place and place, which is a very usefull practice for carrying of water, or of under-ground Adits or Soughs, take these Rules: Let your Instrument be carefully and truly made, whether it be a water Level, or which in my Opinion is the best a brass T, the sights to be two prospect glasses; and such you may have made of Mr. *Marks*, an Excellent Math. Instrument maker, at his house near *Somerset* house towards the *Savoy*, and the water, to him direction is given about it: This kind of Instrument will suffer a distance to $\frac{1}{4}$ of a mile, or more if need be; and there must be two mark-boards placed on pike staves, that your Companions may lift up or down as you shall direct them.

Set the Level as near as you may in the middle betwixt the two Marks, which your Companions hold upright in their hands with the slipping marks, and first turning to one, cause him to hold or set his sight even with the level sights, and so the other; the Difference betwixt those sights in inches and tenth parts gives the ascent or descent: this is for one simple station; but if it

it require many ſtations with aſcents and deſcents, then in a Note-Book ſet down your back ſtations in one Column, and your fore ſtations in another, ſumm up both the Columns, and take the Difference of them; if they be equal, the two places are level; if your fore-ſtations exceed, then the difference is lower; if otherwiſe higher, a little practice will inform you ſufficiently; in carrying a ſtream or River, as the *New Water* from a little above *Ware* to *London*, or elſewhere, you muſt allow a foot, or a foot and two inches for a mile in deſcent, or more, if your fall require it; and this becauſe of the diſtance of the Tangent from the ſurface of the Globe of the Earth in every mile; and though in a mile it will be found but 6 inches, yet it is better to hold to the ſurer ſide. Now for Common Sewers or Paſſages to carry away the water and dirt of ſtreets in Towns; for every ten feet you ought to allow 2 inches or 3 as your fall may be, which in every 100 feet will be 1 foot 8 inches, or 2 feet 6 inches.

3. For the length of unapproachable Lines, as thoſe of places beſieged, or of heights or diſtances, they are found by reſolving a Triangle, that hath one ſide, and all the Angles given, as in *Prop.* 4. of plain Triangles is ſet down, as you may ſee in *Fig.* 3d. Care muſt be had, that the Angle B C D be not too acute, *viz.* never leſs than 2 degrees, and therefore it will be beſt if the ground will give leave, to go from B not in the right line A B D, but to go off from B towards F at right Angles.

For a diverſion I will give the heights of ſome Pyramids, Steeples, Obelisks and Pillars in the meaſure of Engliſh feet; As when St. *Paul's* Steeple had its Spire on, the ſtone work was 260 feet high, and the Spire as much, which was 520 feet in all, and will be found as high as any

Steeple

Steeple in *Chriſtendom*, only that at *Cremona* in *Italy* being 528 feet excepted, the Ball on St. *Peters* in *Rome* is 466 feet; the Steeple at *Roan* in *Normandy* is 399 feet; at *Stratsburgh* in *Germany* 431; at *Landhoven* in *Bavaria* 451; at *Modena* in *Italy* 279 feet; the Tower *Afinel* in *Bononia* in *Italy* 316 feet; Lantern at *Genua* 324 feet; the higheſt of the Pyramids 1350 feet, the lower Pyramids 883; *Boſton* Steeple in *England*, a ſtone ſteeple without ſpire is 264 feet; the height of the Obeliſk in *Rome* removed by *Fontano* to St. *Peters* was of one ſtone 78 feet and a half high, 9 feet 2 inches ſquare at greater end, and 6 feet 2 inches at the top, it ſtands now upon a Pedeſtal of 12 feet and a half high, and the height of the brazen gilded Croſs is 19 feet and half, ſo now the whole height is 110 feet and a half in all.

4. Before we come to the meaſuring Plains, it will be requiſite to ſhew, (1.) To raiſe a Perperdicular from a Line; (*Fig.* 9.) ſuppoſe on *a*, take ab=ac open your Compaſs to above half bc, and croſs two arches at *d*, *a d* is a Perpendicular. (2.) To do it on the end of a Line, ſtrike an Arch *d b*, ſet the ſame wideneſs from *d* to *b*, and ſtrike another Arch at *c*, which with a Ruler laid upon *d* and *b* croſs at *c*, then is *c a* a Perpendicular. (See *Fig.* 10.) (3.) To let fall a Perpendicular from *a* upon the Line bc, (*Fig.* 11.) ſetting one foot in *a*, croſs the Line in *b* and *c*, from *b* and *c*, opening the Compaſſes make a croſs at *e*, lay a Ruler by *a* and *e*, and draw *a d* which is a Perpendicular to *b c*. Laſtly, becauſe hereafter there is great uſe made of a Square, I ſhall ſhew you how any Joyner or skilfull Carpenter may make one that will very well ſerve your turn for ſurveying or plotting any Grounds, Yards or Courts, and for meaſuring the ſame. Get a dryed piece of Box

or

or Pear-tree that will bear 3 inches, or 3 inches and a half Diameter, and turn it flat on the top round, with a neck to fit for the head of a ſtaff; find the Center, and draw 2 or 3 Concentrical Circles, as you ſee (*Fig.* 12.) and Circles on the edge, divide the Circles into four parts, as you ſee in the Figure *a d b c*, then take a whip-ſawe very thin, and ſawe by the marks the two Lines *a b* and *c d* at right Angles pretty deep, this will make a good Inſtrument for ſetting off Perpendiculars when you have occaſion:

Suppoſe (*Fig.* 13.) *a, b, c, d, e, f, g, h,* were a field, I come to *a*, and ſetting a Becon there and at the corners, I meaſure *a c*, and as I go find at what length by the ſquare, the perpendiculars 1 *b*, x *d* and k *b* will be, I meaſure all thoſe Perpendiculars and ſet them down in my Book, I meaſure *c b* and the perpendiculars *m p* and *n o*, and ſo all the reſt as you ſee in the Figure; and to lay the obſervations down, I do no more but draw a Line *a c* by the Scale, and prick down the points *i* k, and x, and raiſing Perpendiculars I ſet off 1 *h*, k *b*, and x d which gives me a, b, c, d and h, I draw c b and upon it prick down *n*, *y*, and *m*, and ſet off *n o* and *m p*, and ſo I work with the reſt of the Figure, and I deal ſo with the reſt of the Cloſes if there be more, and add all together.

Laſtly, to find the length of a Circular Line, either whole or part, from Degrees and Decimal parts, may be done by this Table, the firſt Column are Degrees or Decimal parts, ſecond Radius is Unity, as for *Ex.* 320. & 16′ Dec. parts: *An.* ,56128 of 100000

1	,017453292
2	,034906585
3	,052359877
4	,069813170
5	,087266463
6	,104719755
7	,122173047
8	,139626240
9	,157079633

30-,52359
2 ,03491
1 ,00174
6-,00104
,56128

Note II.

Note II. Planometry, or the measuring the superficies or planes of things is done with the squares of such measures, as a square foot, square inch, square yard, square perch, that is by squares, whose sides are an inch, a foot, a yard, a perch; so that the Area of any superficies is said to be found, when I know how many such square inches, feet, yards, *&c.* it containeth:

1. The Area's of squares and oblongs are known, if you multiply one side by another.

2. The Area of any plain Triangle is gotten, by multiplying the Base by the Perpendicular, and taking half the sum, or the Base by half the Perpendicular, or the Perpen. by half the Base.

Or without the Perpendicular at all, add up all the sides and take half the summ, from this half summ take every side, which call the three Differences, multiply these three Differences, and the half summ continually together, the square Root of the last Product shall be the Area of the Triangle.

3. To measure any Regular Figure that has equal sides, multiply half the summ of the sides by the Perpendicular from the Center to one of these sides: To find the Perpendicular, conceive a Triangle, whereof one side is the side given, the Angle opposite is the ∠ at the Center, the other Angles half of its Complement, to find the Perpendicular.

This Table will presently give you the Quadratrix under Q. or the side under L. for any of the ten Regular Figures, whose side is, 1. *Ex.* Suppose the side of a Pentagon be 70,51 what is the superficies: Say, As 1. 1,312 :: 70,51. An. 92,52 the Quadratrix and 92,52 x 92,52 =

	Q.	L.
Δ	658	1,520
□	1,000	1,000
5	1,312	,7624
6	1,612	,620
7	1,904	,525
8	2,196	,455
9	2,487	,402
10	2,769	,361

8558. Having the ſuperficies take the ſq. Root of it, and ſay, As. 1. ,7624 : : ſo Q. to ſide.

4. The Area of any four ſided figure, two ſides whereof are parallel, is gotten, if you multiply the perpendicular from the one parallel ſide upon the other, by the half ſumm of of thoſe parallel ſides.

5. If the figure be of many ſides, caſt them into Triangles, as you ſee in Figure (13.) And if any ſide be crooked as you ſee *c d* in that Figure, draw a Line that ſhall leave as much out as in; or if it be irregular towards a round, as in Fig. (14.) form a Triangle, as *a d b* that ſhall equal it.

6. The dimenſion of Circles, and other round Figures are gathered from their Diameters or Circumferences; let D ſignifie the Diameter. *P* the Periphery, Dq, Pq the ſquare of the D or P. l. the ſide as before, ⊙, the Circle, R. Radius, or half of the D. Then,

As, 7. 22 or 113. 355, or 1. 3.1415926 : : ſo is any D. to P. and ſo Dq. to the ſuperficies of a ſphere, and ſo is Dx the Axis of a Cylinder. to its ſuperficies, and ſo is half D into the ſide. to the ſuperficies of a Cone; and ſo is the ſquare of the Chord of half the ſegment of a Sphere. to the ſuperficies of that ſegment.

As, 22. 7 or 355. 113. or 1. 0,318310 : : ſo P. D. ſo ſuperficies to the Dq of the Sphere.

As 7x4. 22. or 14. 11. or as 1. to ,785399 : : ſo Dq. Area; and ſo is the ſq. of the Dx l. ſolid: Cylinder. So Dqx $\frac{1}{3}$ Ax: to the ſolid: of the Cone:

As, 22. 7x4 or 11. 14, or as 355. 452 or 1. 1,273239 : : ſo is Area of the ⊙. to the Dq.

As, 22x4. 7, or as 88. 7. or as 1420. 113. or 1. to ,079577 : : ſo Pq. Area of a ⊙. and ſo Pqxl. to the ſolid: of a Cylinder.

As,

As, 1. to ,707107 :: D. to the root of a ſquare to be inſcribed in a Circle. As 1. ,886227 :: D. to the Root of a ſq. equal to the Circle, which is the ſquaring of a Circle.

As 1. to ,80604 : : D. to the Root of a Cube equal the Sphere.

As 1. to 1.772454 : : D. to the Root of a ſq. equal ſuperficies of a Sphere.

As 1. to 3523599 : : Cube of D. to the Sphere.

As 1. to 1;909859 : : Sphere. Cube of the Diameter.

As 1. to 3282095 : : ⊙. to root of a ſquare = to the Area ⊙.

As 7. 22x4. or 1. 12;56371 : : ⊙. Pq.

As 1. 3225072 : : ſo is P. to the root of the inſcribed ſq. in the ⊙.

As 1. 3256556 : : P. Root Cube of a ſolid = the Sphere.

As 1. 3564189 : : P. Root ſq. = ſuperficies of the Sphere.

As 1. 3016887 : : Cube P. to the Sphere.

As 1. 59;217626 : : Sphere. to Cube of the P.

As 7x6. 22. or 1. 35236 : : D cubed. Solid: Sphere.

As 22. 7x6 or 1. 190986 : : ſolidity. D cubed of a Sphere.

A Cone, a Sphere, and a Cylinder, that have the ſame height and Diameter, if the greateſt Circle be equal, are as 1, 2, 3 ; therefore a Cone is $\frac{1}{3}$ and a Sphere $\frac{2}{3}$ of a Cylinder of the ſame height and D'. therefore, As 1. 25;1327 : : ſo D cubed. Cylinder.

7. The practiſe followeth : *I.* In ſurveying and meaſuring of Land ; meaſure with a Perch or Pole = 16 $\frac{1}{2}$ feet divided into 100 parts, then by the aforeſaid Rules how many ſq. perches there are, that is the Area of that Cloſe or ground ; which divided by 160 ſquare perches

(for so many are in an Acre = 40 x 4) it gives you Acres, the Remainder, accounting 40 Perches for a Rood, are Roods and Perches.

	M.	C.	X.
	ac. r. p.	a. r. p.	r. p.
1	6. 1. 0	0. 2. 20	0. 10
2	12. 2. 0	1. 1. 0	0. 20
3	18. 3. 0	1. 3. 20	0. 20
4	25. 0. 0	2. 2. 0	1. 00
5	31. 1. 0	3. 0. 20	1. 10
6	37. 2. 0	3. 3. 0	1. 20
7	43. 3. 0	4. 1. 20	1. 30
8	50. 0. 0	5. 0. 0	2. 00
9	56. 1. 0	5. 2. 20	2. 10

This little Table turns Perches into Acres, Roods, Perches upon sight; the Numbers under ac. are Acres, under r. are Roods: the first Column are either so many thousands under M. or so many hundreds under C. or so many Tens under X.

As for *Exam.* 7854 Perches are given, which I set down as you see, and take the number of Acres, Roods and Perches answering each figure, and it makes in all 49 Acres and 14 Perches. Sometimes as in small Backsides, Courts, or other small places the measure may be by the Foot, and then this Table turns any number of Feet into Acres,

	ac.	r.	p.
7000---	43.	3.	0
800---	5.	0.	0
50---	0.	1.	10
4---		0.	4
	49.	0.	14

	C. M.				X. M.				M.		C.	
	a.	r.	p.	f.	a.	r.	p.	f.	p.	f.	p.	f.
1	2.	1.	7.	36	0.	0.	36.	119	3.	183	0.	100
2	4.	2.	14.	171	0.	1.	33.	126	7.	94	0.	200
3	6.	3.	21.	257	0.	2.	30.	53	11.	05	1.	28
4	9.	0.	29.	65	0	3.	26.	252	14.	189	1.	128
5	11.	1.	36.	150	1.	0.	23.	179	18.	99	1.	228
6	13.	3.	3.	240	1.	1.	20.	106	22.	11	2.	56
7	16.	0.	11.	53	1.	2.	17.	33	25.	194	2.	156
8	18.	1.	18.	140	1.	3.	13.	232	29.	106	2.	256
9	20.	2.	25.	215	2.	0.	10.	159	33.	17	3.	84

Roods and Perches at the first view, to be operated with feet, as the last *Ex.* Roods, Perches, the numbers under feet are odd feet, the second Column is one Hundred Thousands, the third Tens of Thousands, and the fourth M. and the last Hundreds.

One superficies is to another as the squares of their like sides, therefore as the square of 18,5 to sq. of 16,5, or as the squ. of 12 (=144) to the sq. of 11 (= 121) :: so are the Content of in Statute Acres. to the Content in Woodland. and as 144. 196 :: so Forrest. Ac. to Woodland Acres. and as 121. 196 :: so is Forrest Acres. to Statute Acres.

II. In measuring of Pavings, Plaisterings, Wainscottings and Paintings, you use the yard square; or if you measure by feet and tenth parts, then every 9 feet squ. makes a yard, all of them require the whole superficies, therefore you must measure wherever the plane or brush goes. The Paviers must lay good foundations and ram well; the Plaisterers work with good Materials and Size; the Wainscotting well wrought, and the Painters to lay a good ground, and work with Oyl and white Lead.

III. Carpenters work, As Flooring, Partitioning, Roofing, and so Tiling, Slating, nay, lately in *London* the ground Plot of whole buildings are measured by the square of 10 feet = 100 sq. feet; so that if you measured by a 10 foot Rod, and every foot divided into 10 parts all will come into feet, and cutting off the two last figures the Remain will Flores or squ. of 10=100.

Brickwork is measured by the Perch of 16 $\frac{1}{2}$ feet, the best way is to measure by the ten foot Rod last spoke on, and casting up the Area by multiplying one side by another, it will produce

ſquare feet, which by this Table is preſently brought into ſquare Perches: The firſt Column are either ſo many X M. feet or Thouſands or Hund. or Ten feet; as the ſecond, third, fourth and fifth Columns anſwer: Ex. In 36542 ſqu.

	X M.	M.	C.	X.
	p. q. f.	p. q. f.	p. q. f.	q. f.
1	36. 2. 63	3. 2. 41	0. 1. 31	10
2	73. 1. 58	7. 1. 26	0. 2. 62	20
3	110. 0. 53	11. 0. 5	1. 0. 26	30
4	146. 3. 55	14. 2. 52	1. 1. 57	40
5	183. 2. 40	18. 1. 31	1. 3. 20	50
6	220. 1. 35	22. 0. 10	2. 0. 54	60
7	257. 0. 43	25. 2. 57	2. 2. 17	1. 3
8	293. 3. 41	29. 1. 36	2. 3. 47	1. 12
9	330. 2. 25	33. 0. 15	3. 1. 13	1. 22

feet what perches, quarters and feet? *An.* 134 perches, 0. q. 57 feet. This ſuppoſeth that the Brick-work is brick and half thick, but if the wall be more or leſs thick account it by half bricks, as 3 for brick and half, 4 for 2 bricks, 6 for 3 bricks, *&c.* and ſay, As, 3. to any other wall in half bricks: ſo are the perches found by meaſure. To the perches to that other wall in half bricks. Note, that 272 one qr. of ſq. feet, is a perch, 68 one q. 136 half, and 20433 q.

30000	110. 0. 53
6000	22. 0. 10
500	1. 3. 20
40	40
2	2
	134. 0. 57

Tapeſtry is meaſured by the ſtick = 27 inches or three quarters of a yard, in a ſtick = 729 ſquare inches: this Table gives ſticks, quarters

ters and inches anſwering to any number of ſqu. inches. meaſured by inches.

	X M.			M.			C.	
	s.	q.	inc.	s.	q.	inc.	q.	inc.
1	13.	2.	159	1.	1.	88		100
2	27.	1.	135	2.	2.	177	1.	18
3	41.	0.	112	4.	0.	84	1.	118
4	54.	3.	89	5.	1.	172	2.	36
5	68.	2.	65	6.	3.	79	2.	136
6	82.	1.	41	8.	0.	168	3.	54
7	96.	0.	19	9.	2.	74	3.	154
8	109.	2.	176	10.	3.	163	4.	72
9	123.	1.	153	12.	1.	70	4.	172

Board, Glaſs, &c. are meaſured by the foot, divided into 10 or 100 parts, or by inches and

	M.			C.			X.	
	f.	q.	inc.	f.	q.	inc.	q.	inc.
1	6.	3.	28	0.	2.	28		10
2	13.	3.	20	1.	1.	20		20
3	20.	3.	12	2.	0.	12		30
4	27.	3.	4	2.	3.	4	1.	4
5	34.	2.	32	3.	1.	32	1.	14
6	41.	2.	24	4.	0.	24	1.	24
7	48.	2.	16	4.	3.	16	1.	34
8	55.	2.	8	5.	2.	8	2.	8
9	62.	2.	0	6.	1.	0	2.	18

ten parts, and then this Table will turn the inches ſquare into feet, quarters and inches, 9842 ſq. Inc. = 68 f. 1 q. 14.

	f.	q.	inc.
9000	62.	2.	0
800	5.	2.	8
40		1.	4
2			2
	68.	1.	14

In

In either Board or Glaſs, if the breadth be given, to find how much of that breadth will make a foot in length; divide 1. by the breadth in feet and 100 parts, the Quotient gives part of a foot, if by inches, divide 144 (12x12) by inches and parts.

If you meaſure by inches and 8 parts in the Figure adjoyning, you may turn them in feet and ten parts by inſpection, the two middle lines being inches and eight parts, above you have feet and ten parts, below timber meaſure.

Note III. Stereometry, or meaſuring of Bodies, has two Multiplications or three Dimenſions, and is valued by the Cube of ſome famous meaſure; as an inch Cube, a foot, a yard, or perch Cube.

A perfect Cube is known, by multiplying the ſide into it ſelf, and that product by the ſide again.

A parallepipidon, or an oblong Cube, a Priſma, or a Cylinder or Pillar; firſt, get the ſuperficies at the end, and multiply that by the height or perpendicular from the top of the Body to the Plane below.

A Pyramid or Cone is meaſured by the ſuperficies of the Baſe Mult. into one third of the height.

The five Regular Bodies, *viz.* Tetrahedrum, Cube, Octoheurum, Dodecahedrum and Icoſahedrum are meaſured as in the Table: Say,

1. ſide of the Dod:: ,778. Cube.

	Cub.	Side.
Tet.	,490	2,040
Oct.	,778	1,285
Cube	1,000	1,000
Icoſ.	1,318	,771
Dod.	2,002	,507

1. Cubat. of Dod:: 1,285. ſide.

The Cubatrix multiplyed into it ſelf twice gives the ſolid; and is the Cube Root of that ſolid body.

To meaſure the Fruſtrums or parts of Piramids

mids or Cones, (as tapering Timber is) ſupply the Piramid or Cone, ſaying; As differ. of the breadth at the two ends: To the length between them :: ſo the breadth of the greater end. to the whole length of the Pir. or Cone.

This gives you the length of the top part; find as before the ſolidity of the top-part, and the whole ſeverally, ſubſtract the ſol. of the top from the whole leaves the ſol. of the Fruſtrum: Thus *Fontana* found the Obelisk by him removed to St. *Peters* to weigh 529 Tuns 11 C. 2 quarters and 3 l. Averd.

The uſual way for this tapering Timber, is to meaſure the ſuperficies in the midſt, and multiply it by the length, which though it be a falſe Rule, yet if it do it at many lengths, ſuppoſe at every 5 or 6 feet it will be very near.

All bodies one to another are in proportion as the Cubes of their like ſides.

The meaſuring of all bodies that have curv'd ſuperficies or plain -- curv'd, follows:

Spheres, Cylinders and Cones, you have their dimenſions and meaſures amongſt the dimenſions of Circles and round Figures in Planimetry.

To meaſure the truncus or part of a Cylinder that leans, take the ſuperficies of the Circle, and adding the longer and ſhorter ſides of the Truncus, take half, let that be the height.

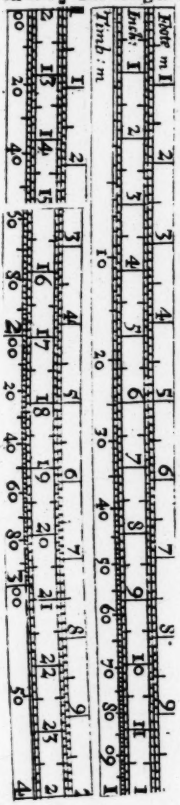
The ſector of a Sphere is meaſured by multiplying its ſuperficies ſpherical, by one third of the height.

The ſegment of a Sphere, meaſure it as if a ſector, and ſubſtract from the ſector the ſolidity of a Cone whoſe Apex is in the Center, and baſe the Area of the ſegment.

The ſolidity of a ſpheroid is gotten by multiplying the greateſt Circle into two thirds of the Axis, about which the ſpheroid is made.

The

The ſolidity of the Trunck of a ſpheroid cut off with two Circles at right Angles with the Baſe, ſuch as our wine Cask are, is gotten, by adding two thirds of the Area of the Circle at the bung or middle, and one third of the Area of the Circle at the head together, and multiplying the ſum by the length.



The ſolidity of an obtuſe Parabolical Conoid is gotten by multiplying of the Area of the Circular baſe in half the Axis, but of an Acute one into 8 fifteenths of the height.

2. The practice for meaſuring ſolids follows: firſt, for meaſuring Timber or Stone, by the foot divided into 10 or 100 parts, multiply as before taught, the Anſwer will be in feet and decimal parts; and if you meaſure by inc. & 8 parts, you may put the meaſure into feet and decim. parts by the Table annexed. But if you muſt meaſure by inch meaſure, caſt all up in ſolid inches, and then by this Table find the ſolid feet, quarters and inches.

324	3 qu.
216	2 qu.
108	1 qu.

If any piece of round Timber or ſquare be given,

ven, and it be desired what length of it will make a foot, divide 1728 by the inches square at the end it answers the Question.

But if you have the superficial Content at the end of the Timber or Stone, and desire to know the solidity of one foot, the Table following will give it you quickly. *Ex.* A piece of Timber at the end is 836 square inches, what Timber in one foot in length. *An.* 5 foot $\frac{3}{4}$ in every 12 inches.

	X M. f. q. inc.	M. f. q. inc.	C. q. inc.
1	5. 3. 64	0. 2. 136	0. 100
2	11. 2. 128	1. 0. 272	0. 200
3	17. 1. 192	1. 2. 408	0. 300
4	23. 0. 256	2. 1. 112	0. 400
5	28. 3. 320	2. 3. 248	1. 068
6	34. 2. 384	3. 1. 384	1. 168
7	40. 3. 16	3. 3. 88	1. 268
8	46. 1. 80	4. 2. 224	1. 368
9	52. 0. 144	5. 0. 360	2. 036

This Table is of Excellent use.

800.	5.555
30.	.208
6.	.041
	5.804

in.	Feet and parts.
1	,00694444
2	,01388888
3	,02083333
4	,02777888
5	,03472222
6	,04166666
7	,04871111
8	,05555555
9	,06250000

In the last figure upon the edge you have a Line called Timber measure, by which and the length of any square Timber you may find the Content, thus instead of the side of your Timber in inch measure and parts, take that of this Line, and multiply that by the length gives the measure.

The General Rule for measuring of Timber that is not square at the ends, is to add both the sides and take half, for the side of the true squ. but this is erroneous; and so much the more as the

the ſides are more unequal, therefore the Area of the end is to be taken: The other errour is in meaſuring round Timber by girding it, and taking one quarter for the ſide of a ſquare equal, but let it be what it will, you muſt take ſuch meaſures as the Countrey uſeth.

Earth-work, as Cellars, Vaults, *&c.* are meaſured by the Yard ſolid, *viz.* 27 ſolid feet, and ſo much ought to be a Cart load, and will be contained well; the Carts ought to be 2 feet 8 inches broad at the Axle-tree within, 2 feet high and 5,5 long.

All Banks that are made to hold out the Sea or Rivers, and all Ramperts, Parapets and Motes, and New Rivers are wrought by the Flore, conſiſting of 18 feet ſquare and one foot deep, which is 324 ſolid feet, which are 12 Cart load, the ſolidity being caſt up: In ſolid feet, this Table ſhewes the floors, q. & feets, 7857 ſolid feet will make 24 floors, as you may ſee in this *Ex.*

	X M.			M.			C.		
	f.	q.	f.	f.	q.	f.	f.	q.	f.
1	30.	3.	37	3.	0.	28	0.	1.	19
2	61.	2.	74	6.	0.	56	0.	2.	38
3	92.	2.	20	9.	1.	02	0.	2.	57
4	123.	1.	67	12.	1.	31	1.	0.	76
5	154.	1.	23	15.	1.	59	1.	2.	14
6	185.	0.	6	18.	2.	06	1.	2.	33
7	216.	0.	16	21.	2.	34	2.	0.	52
8	246.	7.	53	24.	2.	62	2.	1.	71
9	277.	3.	9	27.	3.	09	2.	3.	9

	F.	q.	f.
7000	21.	2.	34
800	2.	1.	17
57	0.	0.	57
	24.	0.	27

For meaſuring Ships, multiply the length of the Keel, the breadth of the mid-ſhip beam, and the depth of the Hold together, devide by 100.

it

it gives you the Tuns, or inſtead of the depth it is uſual to take half the breadth inſtead thereof: But for Merchants that allow nothing for Guns, Maſts, &c. divide by 95. This may give a gueſs at the Tunnage, but there is a great deal more required to give the true meaſure of a ſhip, or the burthen ſhe will bear in ſalt water, for in freſh water the ſhip will ſink more.

To double a Cube, or to give the Cube Root of a Cube that ſhall be double to another given, double the Cubick Inches and parts of the Cube given, Extract the Cube Root; and thus by knowing the meaſures of the ſhip of one burthen, to make another ſhip of the ſame mould which ſhall be double, treble, &c. or any proportion more or leſs, multiply the meaſure of the length, breadth and depth in ſolid feet, then double, triple, &c. the feet, and extract the Cube Root.

The next thing is concerning the ſolidity and proportion in weight, ſeveral Metals, Minerals and Water have one to another.

Note (4.) Concerning Metals, and of the manifold uſes of the Table page 17.

1. If you have the magnitude of any body in ſolid inches, and deſire to know the weight of it in Troy ounces: As, 1. is to the number of ounces and decimal parts anſwering the Metal, Stone, &c. in the Table A :: So is the Cubick inches given. to the ounces in weight required.

2. If you have two ſeveral bodies named in the Table, both of the ſame magnitude or capacity, together with the weight of one to find the weight of the other: As the number in the Column A, anſwering the firſt. to the number of the 2 :: ſo the weight of the firſt. to the weight of the ſecond.

3. The uſes of the Column B are likewiſe

two; 1. To know the magnitude in inches of any Body by the weight in ounces; As, 1. to the inches and parts in this Column of the Metal, *&c.* propoſed:: ſo the weight given. to the inches in magnitude. ſought.

4. Two ſeveral Metals, Stones, *&c.* both of one weight, and the bigneſs of one in inches; ſay, As the number in Column B ſtanding againſt the firſt. is to the number againſt the ſecond:: ſo is the magnitude of the firſt. to the magnitude of the ſecond in inches.

5. The uſes of the Column C ſhews the weight that every inch of the ſeveral bodies will weigh in water. From *Archimedes* we may ſay, that all Bodies let into water are either heavier, equal, or lighter than ſo much water equal the magnitude; if heavier then the body will ſink, if equal then the bodies utmoſt ſurface will ſwim even with the top of the water, if lighter then ſo much of the body will ſink into the water, ſo as the quantity of water, which might be equal in bulk to ſo much body as ſhall ſink, ſhall weigh equal to the weight of the whole body propoſed. Again, a body heavier than water, is lighter in water when weighed, by the weight of ſo much bulk of water equal to that body; Hence it is eaſie to diſcern the weights of ſeveral bodies in and out of water by the Columns A and C, A is the weights in Air, C in water, where it is plainly ſeen, that Gold being ſcarce, the half quantity of Silver or Braſs doth ſcarce loſe half ſo much of its weights as Silver or Braſs will; and from this conſideration *Archimedes* judged of King *Hiero*'s Crown. By the Column C; as 1. is to the number anſwering the body:: ſo the ſolid inches of any body given. to the weight in water.

Now it will be convenient to give you theſe Tables

Tables for converting ſolid inches into weights of water Averd.

	(1.) Averdup. Ounces.		(2.) Inches and parts.
1	0,579522	1	1.72556
2	1.159044	2	3.45112
3	1,738566	3	5.17668
4	2,318088	4	6.90224
5	2.897611	5	8,62780
6	3.477133	6	10.35336
7	4.056655	7	12.07892
8	4.636177	8	13.80448
9	5.215699	9	15.53004

The firſt turns ſolid inches of water into oun. Averdupois.

The ſecond turns ounces Averd. of water into ſolid inc.

Ex. In an Ale Gallon = 282 ſolid inches, how many ounces Averdupois? by the (1.)

Anſw. 163 oun, ,426 = 200. 115,904400
10 l. 3 oun, ,426 80. 46,361776
ſo in 500 oun. of wat. there is 2. 1,159044
862,78 ſolid inch. by the (2) 163. ,426

And in a foot ſolid there will be anſwering 1728 ſolid inches, 62 l. 9 oun. ,414

The neareſt proportion in Troy weight that 36 ſolid inches will hold 19 ounces Troy of water, and one pound Troy of water will fill 22,7368 inches, and one pound Averd. 27,609: A foot ſquare of water is equal 76 pound Troy.

Hence is found a very good way for meaſuring any Irregular Body, that by no Mechanical Art otherwiſe can be done. Fill any veſſel brim full of water, and then dipping in your body receive carefully all the water that runs over, and weigh it, and by the laſt 2 Tables turn that weight into ſolid inches. Otherwiſe, if your veſſel be Regular that holds the water, obſerve the riſing of the water and find the ſolid feet or inches anſwering.

Hence it is, that expert Builders of ſhips have great conſideration of all the premiſes in

this Section, for by the weight of the ſhip, and all appurtenances, they judge to what depth ſhe will ſink, and herein the Ingenious Cap. *Dean*, one of his Majeſties Commiſſioners of the Navy, has exerciſed abundance of skill, though for all the Art one can have, long experience and good judgement will be required, for as I had it from the ſaid Capt. *Dean*, that the proportion betwixt dried Oak and freſh feld, is as 14 to 17; So that conſidering the ſtrange forms of the Keel, and bends of ſhips, and many ſuch and more accidents, as that before of Oak wet and dry, it is a difficulty inſuperable to give to an inch the depth a ſhip will draw when rigg'd and fitted out.

Laſtly, if it be propoſed to make a piece of Iron ſwim in pure water, you muſt make it ſo hollow that it may be capable to hold as much water, that will be equal in weight to the Iron and ſomething more.

Note 5. Of Gaging of Veſſels. The Gallon which is the grounds for this work, take as it is now allowed and uſed; Gallon for dry meaſure, is 272 ſolid inches; for Wine 231; for Beer and Ale 282.

		X M.			M.			C.			X.	
		g.	p.	in.	g.	p.	in.	g.	p.	in.	p.	in.
I	1	43.	2.	09	4.	2.	18	0.	3.	13	0.	0
	2	86.	4.	18	8.	5.	7	0.	6.	26	0.	20
	3	129.	6.	27	12.	7.	26	1.	2.	11	1.	1
	4	173.	1.	8	17.	2.	15	1.	5.	24	1.	11
	5	216.	3.	17	21.	5.	5	2.	1.	9	1.	21
	6	259.	5.	16	25.	7.	22	2.	4.	23	2.	2
	7	303.	0.	6	30.	2.	12	3.	0.	6	2.	12
	8	346.	2.	16	34.	5.	3	3.	3.	19	2.	22
	9	389.	4.	25	38.	7.	20	3.	7.	5	3.	3

Sol. Inches into Wine Q

Inc. into Beer and Ale G.		XM. g.	p.	in.	M. g.	p.	in.	C. g.	p.	in.	X. p.	in.
	1	35.	3.	24	3.	4.	13	0.	2.	29	0.	10
	2	70.	7.	13	7.	0.	26	0.	5.	23	0.	20
	3	106.	3.	2	10.	5.	3	1.	0.	18	0.	30
2	4	141.	6.	26	14.	1.	16	1.	3.	12	1.	4
	5	177.	2.	15	17.	5.	29	1.	6.	5	1.	14
	6	212.	6.	4	21.	2.	7	2.	1.	0	1.	24
	7	248.	1.	28	24.	6.	20	2.	3.	30	1.	34
	8	283.	5.	17	28.	2.	33	2.	6.	24	2.	8
	9	319.	1.	6	31.	7.	11	3.	1.	18	2.	18

Inch. into dry measure.												
	1	36.	6.	4	3.	5.	14	0.	2.	32	0.	10
	2	73.	4.	8	7.	2.	28	0.	5.	30	0.	20
	3	110.	2.	12	11.	0.	08	1.	0.	28	0.	30
	4	147.	0.	16	14.	5.	22	1.	3.	26	1.	6
3	5	183.	6.	20	18.	3.	2	1.	6.	24	1.	16
	6	220.	4.	24	22.	0.	16	2.	1.	22	1.	26
	7	257.	2.	28	25.	5.	30	2.	4.	20	2.	2
	8	294.	0.	32	29.	3.	10	2.	7.	18	2.	12
	9	330.	7.	2	33.	0.	24	3.	2.	16	2.	22

So that by these three Tables, if you cast up the Content of any Measure or Cask into solid inches, you may easily find the Gallons under g, Pints under p, and inches, either for Wine by the first, Beer and Ale by the second, and dry measures by the third. One *Example* for all:

In Wine, suppose 9845 inches, it will make 42 Gall. 4 pints, and 26 inches.

	g.	p.	in.
9000	38.	7.	20
800	3.	3.	19
45	0.	1.	15
	42.	4.	26

Thus for all Bushels, Pecks, and all other Measures in Cylinders, get the Area of the Circle in inches, and multi-

ply it by the length, it gives the ſolid inches: For the Area, ſay, 1. 0,78539 :: ſo Dq. Area. or eaſily by the Log: Add the Log: of the Diameter doubled, to this Log: 3,895085, it gives you the Area deſired: But in meaſuring the Spheroid or Hogſheads, and other Veſſels ſo figured, as you were taught before, you muſt take two thirds of the Area of the Circle at the Bung.

Viz. 1. 0,5236 :: ſo Dq. to $\frac{2}{3}$ Area.

and 1. 0,2618 :: ſo Dq. to $\frac{1}{3}$ Area.

The Log. for two thirds is 3,718999. for 1 third. 3,417969 to be uſed as before.

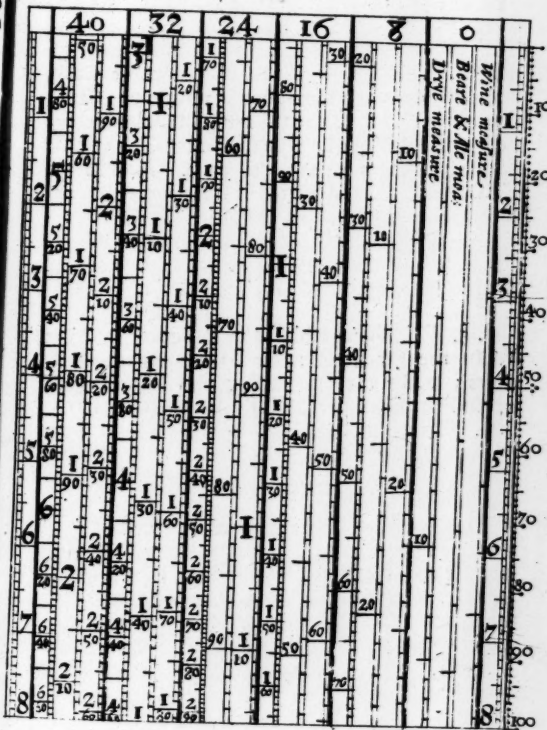
If you will not meaſure by inches but by a Gallon Rod, you muſt take the Cube Roots, of 272,25, of 231 and 282, which are 6,481. 6,134 and 6,557, and making ſcales of gallons, ſet theſe meaſures by compaſſes taken from a Diagonal ſcale of an inch, upon your Ruler exactly, and divide the ſame into 100 parts, ſo is your Rod fitted to meaſure by gallons, and 100 parts. *Ex.* A veſſel at the head by the Rod 3 gallons, whoſe ſquare is 9, at the bung 5,5 whoſe ſquare is 30,25. ſay, as 1. 9 :: ,2618. 2,356 = 1 third of the Area. and 1. 30,25 :: ,5236. 15,839. two thirds of the Area at the bung, and 2,356 + 15,839 = 18,145: Now 18,195x6,8 the length produceth 123,73 that is 123 gallons, and almoſt 6 pints.

Here is a printed Figure has all the three Lines, Wine meaſure, Beer and Ale meaſure, and dry meaſure; the firſt two are one third of the Areas, the laſt for Cylinders is the whole Area; on either edge is a Line of 8 inches, every inch into 10 parts, the ſcale is broken into 5 parts, which makes 40 inches, by an *Example* it will be plain.

A Veſſel

A Veſſel of Wine, at the head 18 inches, at the bung 32 inches, length--40 inches.

I ſeek 18, I find it in the ſecond row 1642, and 37 in Wine meaſure; for a third againſt 32.



I find

I find 1,16, which doubled gives 2,32; now 337 4 2,32 = 2,69 x 40 = 107,60, which is 107 gallons and a half.

For Dry measure take the whole Area, because of Cylinders.

At the latter end of the Book I have inserted Mr. *Philips* his Table for the Gaging of Wine-Cask that are not full, it is made to Gallons and half Gallons, and by proportioning may go nearer. Find the Content of the whole Cask, and find how deep the liquor is within the Cask; say, as the Diameter at the bung in inches. to the depth of the Liquor :: so the Rad. of the Table 10000. to the proportional part. Find in the Table the Gall. and parts that answer that part propor. Then say, as 63 Gallons the Gallons of the Rod. is to the proportional Gallon found :: so Content of the whole Cask. to the Content of the Liquor in the Cask.

§. 5. This Paragraph shews Rules of Practice; 1. In the Embatteling and Ordering of Souldiers; 2. In the Quartering and Encamping; 3. In Fortification; and 4ly in Gunnery.

1. Though this Curiosity to a skilful Sergeant Major will not be material, yet to a young beginner, and even to the better practised Souldier it will be helpful.

To Order Souldiers into a square Battel of men, take the square Root of the Number, that shall be the side both for Rank and File: But if they be to be ordered into a double Battle, take the square Root of half the Number, and that will be the number in File, and twice so many in Rank, and if it be demanded to Order them four times as many in Rank as in File, take the square Root of a fourth part.

To Order them into a square Batt. of ground, you may distinguish them into Order and open Order.

Order --- Order when the centers of their places are distant 3 feet and a half in Rank and 7 in File, open Order when the Centers are 7 feet both wayes. If it be a square Battle of ground, and the Center of their distances in Order; then as 1, 2 :: so the Number of men. to another Number whose square Root is the Number of men in Ranck : So by the help of extracting of a square Root, these sort of questions are easily resolved.

2. For the Quartering and Encamping of Souldiers called Castremetation, it is requisite, the Quarter-Master-General be skilled in measuring, and all the under Quarter-Masters ought to be skill'd at Foot measure, that they may lay out their Quarters as directed.

Three hundred feet is the common allowance for the depth of ground that a Regiment whether of Horse or Foot should take up, the wideness must be answerable to the number of men. Two hundred feet for the Huts in length, and One hundred for the Commanders and Sutlers before them; every two Souldiers to a Hut, 8 feet broad and 8 deep, two feet one Hut from another, so that there may be 20 Huts stand in the 200 feet, the Alley betwixt Hut and Hut may be 8 feet, that is, 16 feet in width, and 200 in length for 40 men, which is 3200 feet, and for the 100 feet more 1600 feet, in all 4800, and there must be 25 Rows for 1000 men; so that for a Regiment of 1000 Foot, with Officers and Sutlers, will take up 120000 feet, which by the Table aforegoing for turning feet square, in Acres will be 2 ac. 3 r. which because of wayes may be made 3 ac. of ground for every Regiment, which may be 350 feet deep, and 370 wide, or near 360 square.

Now if 1000 Men, Officers, Sutlers, Highwayes and all, take up a square of 360 feet, how many

many feet ſhall the ſide of a ſquare be) to lodge 10000 Foot men, &c. ſay, 1000. 10000 : : ſo is the ſquare of 360=129600. to the ſquare 1296000. whoſe Root is the feet required, *viz.* 1138 feet, which is very near thirty Acres of ground.

For quartering of Horſe you muſt keep the ſame depth of 300 feet for all, and take 200 feet for the Huts, the Horſe Huts muſt be ten feet deep and four wide, twelve Horſes will ſtand in a Hut together, which is 48 feet long, and 10 wide, and 6 feet a ſtreet; the Huts for the Troops will be 6 for 12 Troops, and ſo imagine a Regiment conſiſt of 8 Troops, 50 to a Tr. it will take up, leaving 20 feet ſtreets and croſs-wayes, very near as much ground as the Regiment of Foot, wayes and all 360 feet = 3 Acres; ſo that ten Regiments will take up 30 Acres: you may very well allow as much ground, as both Horſe and Foot will take, for the General, Train of Artillery, Victualers, &c. and parade places; ſo that 120 Acres will well Camp 15000 Horſe and Foot, and all Proviſions beſides: From theſe conſiderations you may be enabled to Encamp an Army.

III. Note. Concerning Fortifications; by cuſtome and uſe (neither great or ſmall ſhot bringing ſuch danger as the Fear) Forts and Fortifications are leſs conſiderable, and are taken in a ſhort time, therefore the late Ingeneers have thought fit to lay open the Flanks, and to diſpoſe the Works, ſo as they may receive more Cannon, that the Enemy may be kept back from approaching too faſt, for all that can be done is to get and obtain time.

I have not room to be large, you may peruſe Modern Fortifications Printed lately, and there you may find ſeveral varieties.

I will ſet down theſe two Tables, and their uſes

uſes, which are ſo ſhort and plain, and will be at hand, that more ſhall not be needed, ſuppoſing the Reader already ſeen in the Rudiments of the Art.

First Table:	Capital,	Gorg.	Flank,	Curtain.
	333:	200:	150:	600:

Sec. Tab.		4	5	6	7	8	9	10
	Capital	398	437	367	333	312	300	291
	Gor. Li.	155	196	203	242	252	260	263

Both the Tables ſuppoſeth the Interior Polygon to be divided into 1000 parts. Then if you deſire that the Flanks ſhall ſtand at right Angles with the Curtain, then by the firſt Table, if your Figure be an Hexagon, divide *p p* (*Fig.* 16.) into 1000 parts, make *p a* 333. *p c*, 200, and raiſing *e f* at right Angles to *p p*. make it 150, draw *f a* the Faces, and *c c* the Curtain, you may complete the work: But if you will not make the Flank at right Angles to the Curtain, but open it a little and have no ſecond Flank, according to *Travaux de Mars*, ſet off the Capital and Gorg as before, raiſe the Flank at 98 degrees to the Curtain, and laying your Ruler on *a*, &c. draw the faces.

Note that this proportion is $\frac{1}{3}$ of the Interior Polygon for the Capital, and if you uſe $\frac{1}{5}$ or $\frac{1}{7}$ for the Gorg and Flank it will be well.

The ſecond way ſets the Flanks at right Angles to the Lines of Defence; For *Ex.* in the (*Fig.* 17.) Let it be an Heptagon, divide the ſide into 1000 parts, look in the ſecond Table under 7, ſet off 333 for the Capital, and 242 for the Gorges, draw occult Lines from *a* to *c*, which are the Lines of Defence, and raiſe Perpendiculars from the points *c*, and draw *c f* for the Flanks, and *f a* for the Faces, this being well underſtood

underſtood may be applyed likewiſe to Irregular Figures.

The fourth and laſt *Note* concerns *Gunnery*, or the Qualifications that Able Gunners ought to have:

Firſt, he ought to have competent skill in *Arithmetick*; to keep his Accounts fair, and to enter in his Diary all notable ſhots and occurrances in his Art, to be able to caſt up the quantity of powder fit for each Peece, the weight of ſhot of all ſorts, whether Lead, Iron or Stone; to work the Golden Rule in Proportions, to extract the Cube Root, which are formerly taught in this Book: He ought to have skill in *Geometry*, to take *Heights* and *Diſtances*, to know the Diviſions of his Circle, Quadrant and Quadrate, to know how to Level, and to lay Plat-forms, and to raiſe Batteries, and though Ordinary Gunners may be excuſed from all this Knowledge, yet Maſter Gunners, and thoſe that deſire to be knowing in this Profeſſion muſt not hereof be ignorant.

He muſt know his Peece and Name which are taken from the height of the Bore, as in this Table annexed, which gives in the firſt Column the Names of the Peeces, next the weight of fortified Guns, the third the height of the Bore, the fourth the height of the ſhot, fifth, weight of the ſhot, ſixth powder for proof, ſeventh powder for ſervice, eighth Paces (five foot to a pace) the Peece ſhoots point blank, or upon the Level, ninth, the utmoſt random the Peece mounted to 45 degrees, tenth the Horſes, and 11*th* the men required to draw a Peece.

Names.

Names.	Guns weight.	Height bore.	Height ſhot.	Weight of ſhot.	Powder for proof.	Powder for ſervice.	Paces point Blank.	Utmoſt Random.	Horſes to draw.	Men to draw.
	C.			li.	lib.	li.				
Can. 8.	70	8	7.75	63	28	23	180	1800	18	100
Can. 7.	604	7	6.75	42	24	18	180	1800	16	80
Dem.C.	504	6.3	6.05	32	20	15	180	1800	12	60
24 l.	404	5.87	5.62	24	17	11	180	1810	10	50
Culv.	40	5.32	5.07	18	14	10	184	1840	8	50
12 l.	35	4.46	4.64	12	10,5	8	178	1780	6	40
Dem.C.	30	4.25	4.03	9	9	7	175	1750	6	35
Saker.	20	3.58	3.40	5¼	5.25	4	160	1600	4	25
Minion.	12	3.35	3.18	4	4	3	120	1200	3	16
Falcon.	5	2.68	2.54	2½	2	1.5	120	1200	2	10

Next he muſt learn from ſome Gunner the Parts of a Peece of Ordnance; the *Caliber* or height of the *Bore*, the *Hollow Cylinder*, the *Chamber* from the touch-hole to 2 feet or 18 inches where the powder and ſhot lye, the uppermoſt part next the Breech is the *Baſe Ring*, thoſe Rings from whence the Peece grows leſs are called the *Freezes*, the uppermoſt of the Metal or Freeze at the Mouth is called *Muzzle-Ring*; thoſe two knobs that hold the Peece in the Carriage are the *Trunions*, the thickneſs of the Metal is commonly meaſured at the Touch-hole, the Trunions, and the neck: And all theſe as the meaſure of Ladles, the length and the thickneſs, and bigneſs of the Carriage, the Trunions and many other things, were formerly taken from the height of the Bore. He muſt alſo

be ready at all the Names about the Carriage of his Peece, *viz.* to know the Sides or Cheeks, the Axtree, Spokes, Nave, Hoops, Tranſomes, Bo'ts, Plates, Hooks to draw by, the Clout, the hole for the Linſpin, the Shafts, the Thill and Thill-bolt, the Fore-locks and Fore-lock-keyes, Capſquares, the Fore-lock pins and chain, the Pintle and bolt hole, the Fellows, Nayles, Bars over the Fellows, Stirrops, the Ruts of the wheele, Dowledges, Beds, Coines, Levers, Hand-ſcrewes, *&c.* and to have ready his Ladles, Spunges, Cartridges, whether of Paper or Canvas, Formers of all ſorts, Sheep-skins to make Spunges, Powder, Shot, Needles, Thread, Starch, Marlyn, Twine, Nayles, Hand-ſpikes, Crowes of Iron, Budg-barrels, Baskets, *&c.* Theſe being the General things he is to know and have ready, he is in Particular,

1. To *Tertiate* his Gun, that is to know the thickneſs of the Metal, at the Touch-hole, Trunion and Neck, by which you judge at the ſtrength of the Gun, whether well fortified or no, this you do with a Coliper pair of Compaſſes, and if the Peece be home-bored, the Diameter leſs by the height divided by 2 is the thickneſs at any place, he muſt ſearch his Gun for honey-combs with a ſearcher, or by reflection of a Looking-glaſs, that the Trunions be well placed, that the Peece be neither top-heavy or otherwiſe, whether the Peece be bored awry or no.

2. To *Diſpart* his Peece, that is, to ſet ſuch a mark upon the muzzle Ring or thereabouts, that a ſight line taken upon the top of the Baſe Ring againſt the Touch-hole by the mark ſet at or near the muzzle may be parallel to the Axis of the Concave Cylinder. To do this, take the Diameters of the Baſe Ring, and the place at the muzzle where you intend the Diſpart to ſtand,

ſtand, divide the Difference of theſe two into two equal parts, and one of them will be the Diſpart, which ſet upon the Gun with pitch or wax, or which is the beſt way to frame a Diſpart as you ſee in the *Fig.* (18.) and tye it about the neck of the Gun with marlyn or twine: But if you have not Compaſſes meaſure the Circles about and work with them.

3. To be knowing in the weights of his ſhot, which he may do by knowing the weight of one; as a Bullet of Iron of 4 inches Diameter, is found by Experience to weigh 9 l. Say, as the Cube of 4 is to 9 l:: ſo is any other Diameter Cubed. to its weight: or as 9 l. is to the Cube of 4:: ſo is any other weight. to the Cube Root of its Diameter. Lead and Iron are in their weight near, as 2 to 3, that is, a ſhot of 2 l. of Iron, and a ſhot of 3 l. of Lead will have the ſame Diameter or height. Iron to Stone is as 3 to 8. Lead to Stone as 4 to 1, that is, a bullet a Stone of 10 l. is equal in height to a bullet of Lead of 40 l. Therefore knowing what a bullet of Iron of any Diameter weighs, you may find the weight of a bullet of the ſame Diameter of Lead or Stone, by ſaying, for Lead having the weight of 9 l. of Iron for 4 inches: if 3 give 2:: what ſhall 9. 6 and for Stone if 8 give 3:: 9 l. 3,375 and ſo of any other: if more exactneſs be required, ſeek for it in the Table of Metals, *Pag.* 17.

4. As the ſhot is regulated by the Cubes of the Diameter, ſo is the powder; ſuppoſe one pound and half of powder be a charge for a Falcon of 2,68 Bore or Diameter, what weight in powder will be fit for a charge of Cannon of 7. Say, as the Cube of 2,68. to 1,5 l. of powder:: Cube of 7. to 25.

The Logarithms facilitate this work, the Log°

of 2,68 is 0.428135 x 3 = 1.284405 of 1,5. 0.176091. of 7 is 0.845098 x 3 = 2535294 now 0.176091 + 2535294 = 2.711385——1.284405 = 1.926980, which is the Log. of 26,73, which is much above the allowance.

5. To know whether his Peece be true bored, the Maſter Gunner muſt ſhew him, for that is only practice, by taking the differences of the Diſparts from a fitted Cylinder of wood for the Bore.

6. For the ſhootiug in great Guns, and the knowledge of the true diſtance that any Peece will carry to, is a matter that depends upon many uncertainties, an exact anſwer will never be given to ſuch queſtions, there is ſuch varieties in the trueneſs of the Bore, in the heights of the ſhot, in the ſtrength of the powder, in the Diſparts, in the levelling and direction, in the Air, Wind, *&c.* But for all theſe Difficulties an Able Gunner will go near the mark, and he conſiders *Point blank*, or *Right Ranges*, the *Middle Ranges* and *Utmoſt Ranges*; the former Table gives you the Level Ranges of each Peece, under the Title of Paces point Blank, five feet to a Pace, which is the beſt diſtance for Batteries; the ſame gives you the utmoſt Random accounted near ten times the former level Range; and for all other Mountures while Gunners have agreed, which I ſhall not live to ſee, take this Table to every ſix points of the Gunners Quadraat for theſe Guns, *viz.* to 45°.

Cannon

	1	2	3	4	5	6
Cannon of 8.	750	1275	1590	1710	1785	1800
Cannon of 7.	675	1147	1431	1489	1606	1620
Dem. Cannon	625	1062	1325	1425	1487	1500
Culver.	750	1275	1590	1710	1785	1800
Dem. Culv.	725	1232	1537	1653	1725	1740
Saker.	625	1062	1325	1425	1487	1500
Minion.	450	765	954	1026	1071	1080
Falcon.	550	935	1166	1254	1309	1320

For ſhooting in Mortar-Peeces, which are elevated above 45 degrees and nearer to 90; you muſt uſe much practice to come to be perfect, after a ſhot or two be made you will be beſt able to judge how you muſt order your Gun, keeping ſtill to the ſame powder, the alteration whereof will alter the ſhots Random, you may have Tables in moſt Books of Gunnery, which you may prove and approve.

§. 6. *Problems* for Practice of *Plain and Spherical Triangles* upon the Sphere in Plano, with the ordinary Proportions thereupon, *Problems* in *Geography* and *Navigation*; *Dyalling*; a *New Projection of the Sphere*; *a particular Dyal.*

Prob. 1. Of theſe three, the length of a *Perpendicular ſtile* upon an Horizontal Plain: 2. The length of the *Shadow*: 3. The Altitude of the ☉ above the Horizon, any two being given to find the third, ſee (*Fig.* 19.) Say, as in plain Δ^s, as AC. AB :: Rad. cot of ABC the upper edge of the ☉ + 15′ the height of the Center. Turn the Figure upwards, it is the ſame upon a vertical wall.

Prob. 2. Of theſe Three; 1. The *Meridian Alt.* of the ☉ or ✳; 2. The *Elevation of the Pole*; 3. The *Declination of the* ☉ or ✳ any

two given, to find the third. For Alt. Equinoctial (which is alwayes the Complement of the height of the Pole)——Merid. Alt. = Declination South. or Merid. Alt.——Alt. Equi. = Declination N. The greateſt Declination is found now conſtantly to be 23 deg. 30′.

Prob. 3. Of theſe Five; 1. The greateſt Decl. ☉. 2. Longitude of the ☉ from the next Equi. point; 3. The ☉ Right Aſcenſion; 4. The Decl. ☉ in that place; and 5ly, The Angle of the Ecliptick with the Meridian, any two being given to find the reſt: For in (*Fig.* 20.) the △, ♈ ☉ *a* right ∠ at a, ∠ at ♈ is the firſt part in the *Problem*, ♈ ☉ the ſecond, ♈ *a* the third, *a* ☉ the fourth, and the Angle ☉ the fifth, any two being given, the other three may be found by the Rules for right Angl'd △s before taught. Note that the Longitude of the ☉ and its right Aſcenſion from the beginning of *Aries* are true in the firſt Quadrant, but muſt be ſubſtracted in the ſecond Quadrant, and added in the third from or to 180°. in the fourth Quadrant muſt be ſubſtracted from 360.

Prob. 4. The *Right Aſc.* ☉, the hour of the day, the right Aſcenſion of Mid-heaven, any two being given to find the third, for the right Aſc. ☉ + Time from Noon = right Aſc. of Mid-heaven and Time from Noon = right Aſc. of Mid-heaven——right Aſc. ☉, and right Aſc. ☉ = right Aſc. of Mid-heaven—— Time from Noon.

Prob. 5. Of theſe Six: 1. Elevation of the Pole; 2. Decl. ☉ or ✳; 3. Altitude of the ☉ or ✳; 4. The diſtance of the ☉ or ✳ from the Meridian; 5. The Azimuth of the ☉ or ✳ from the North; 6. The Angle of the ☉ or ✳ ſhewing its Poſition in reſpect of the Pole or Zenith, any three given to find the reſt: For in the Oblique angled △, Z ☉ N. Z N. is the complement

plement of the Elevation, the firſt, N ☉ the the complement of Dec. the ſecond, Z ☉ the complement of the ☉ Alt. the third: The Angle at N is the diſtance of the ☉ or ✳ from the Merid. = to the time of the day the fourth, the Angle at ☉ is the fifth, and at Z the ſixth.

Prob. 6. Of theſe Five; 1. The Elev. Pole; 2. ☉ Decl. 3. ☉ Alt. at 6; 4. ☉ Azimuth at 6; 5. The ☉ Poſition in reſpect of the Pole and Zenith; any two given to find any one of the reſt, for in the right angled Δ b ♈ c. ∠ at ♈ is the firſt, ♈ b the ſecond, b c the third, ♈ c the fourth, and the ∠ at b the fifth.

Prob. 7. Of theſe Five. 1. Decl. ☉. 2. Elevation of the Pole; 3. The Amplitude of the ☉ riſing or ſetting; 4. The Angle of the Horizon and Merid. at the ☉ riſing; 5. The time from Midnight, any of theſe two being given to find any of the reſt; for in the right ∠Δ d N O, d N is the complement of Declination the firſt, N O the ſecond, d O the complement of the third, ∠ d the fourth, ∠ N the fifth.

Note, That the Angle at N or ∠ d N o, is the compl. of the Aſcenſ. Diff. which might be found alſo more clearly in the Δ ♈ f d, under the Hor.

Note, That the Aſcenſional Difference turned into time, by allowing for every degree 4′ of time ſheweth how far the ☉ riſeth from ſix a clock, may be the time of the ☉ riſ. and ſetting.

Note, That if the Elevation of the Pole, and ☉ Decl. be both either North or both South, then the right Aſc. —— Aſc. Diff. = obl. Aſcenſion, and added = oblique Deſcenſion; but if the Elevation of the Pole, and ☉ Dec. be the one North the other South, then add for the oblique Aſcenſ. and ſubſtract for the Deſcenſion.

Note, For the Not-riſing or Not-ſetting of certain Stars. 1. If the Elevation of the North Pole be greater than the Complement of the

North,

North Declination, then that ſtar ſetteth not, or than the South Decl. then that ſtar riſeth not; and if the Elevation of the South Pole be greater than the Complement of the South Declination of the ſtar, then that ſtar ſetteth not, if greater than the North Declin. then that ſtar riſeth not.

Note, That if you double the ☉ ſetting it is the length of the day, ☉ riſing the length of the night, and half of that is the ſemidiurnal Arch.

Note, Becauſe the obtaining of the Hour and Azimuth is very uſeful by taking the height of the ☉, I will here ſet down an *Exam.* of them both, after the manner of the laſt *Problem* in Spherical Δ^s. In the Lat. 51. 30. the ☉ height 32°. the Decl. 18°. firſt for the hour, then the Azimuth.

Hour.

Co. pole 38. 30 ar. ſi. 0.205850.
Co. Dec. 72. 00 ar. ſi. 0.021723.
X---33. 30.
Co. Ht ---- 58. 00.
Z---91. 30.
X---24. 30.
Half Z 45. 45 ſine 9.855096.
Half X 12. 15 ſine 9.326699.
Z. 19.409368.
Sine 30°. 26'. half Z. 9 704684.

The Hour 8 a clock and one minute.

Azimuth.

Co. pole 38. 30. az. ſi. 0.205850.
Co. Ht. 58. 00. az. ſi. 0.071579.
X--19. 30.
Co. Dec. ---72. 00.
Z---91. 30.
X---52. 30.
Half Z---45. 45. ſine 9.855096.
Half X-- 26. 15. ſine 9.645706.
19.778231.
50°. 47'. half 9.889115.

The Az. 50°. 47'. from the South.

Note

Note II. Of *Geography*, which is the knowledge of the Habitable World, and the measures thereof; first, you must know that the Latitude of any Place is the distance of it in degrees and parts from the Equinoctial; the Longitude is the distance from the first Meridian placed by *Ptolemy* in the *Canaries*, but the most of the latest Geogr. place it in the *Azores*. From West to East the Account is by degrees and parts, or by hours, accounting 15 degrees to an hour, and for every degree 4 minutes, and every minute 4 seconds.

The *Zones* are *five*; 1. The *Torrid* Zone betwixt the Tropicks, two *Temperate* betwixt either Tropick and the Artick and Antartick Circles, and two *Frigid* from them to both the Poles.

The *Climates* and Parallels lye parallel to the *Equator*. A *Climate* is a *Zone* or Girdle that is contained betwixt two Circles parallel to the Equator, those Circles have the longest days differing half an hour, the middle Circle betwixt them has a quarter of an hour difference from the Extremes.

In respect of the shadows, the Inhabitants are differenced into *Amphiscii*, whose shadows are sometimes in a year round about them, East, West, North and South, being those that inhabit the Torrid Zone. *Heteroscii*, those that have their shadows one way as in the Temperate Zones. *Periscii*, those that in a day may have their shadows round about, as in the Frigid Zones.

In respect of the situation, the Inhabitants are *Periecians* that dwell under the same Meridian, and in one parallel diametrally opposite in that parallel, they have the same Winter and Summer at contrary times, unless in the Frigid Zone; *Antecians* dwell in like parallel from the

Equator,

Equator, the one North, the other South, and under the ſame Meridian and Longitude; *Antipodes* are thoſe that are Diametrally oppoſite by the Center of the Earth: they have contrary Winters and Summers, and dayes and nights contrary, if out of the Torrid Zone.

The next thing is to conſider the Maps, firſt of the World in General; which have theſe Circles, the *Equinoctial*, *Ecliptick*, *Tropicks* of *Cancer* and *Capricorn*, *Circles Artick* and *Antartick*, *Meridians* and *Parallels*, ſuch a Map ſhews the Effigies of the Globe of Earth *in Plano*, and in it you conſider what places are North, South, Eaſt or Weſt by the Meridians and Parallels, and conſidering any province or place, you preſently ſee how it is poſited to the North or South by its Latitude, to or from the firſt Meridian by its Longitude, then in what Zone or Climate, what is the longeſt day, Latitude, Longitude; and it is conſiderable that Geographers make the right ſide of a Map the Eaſt, the left Weſt; the North the higheſt, and South the loweſt parts: next for the diſtance of Miles, the *Italians* and *We* account ſixty to a degree, which would anſwer a mile for a minute, but it holds not true in either, for according to Mr. *Norwood*, near 70 miles *Engliſh* makes a degree, and in *Italy* at *Bononia* according to *Ricciolus* 66; however let the account be 60 to a degree, and then to reduce thoſe to *Engliſh*, ſay, as 6. to 7:: ſo is *Engliſh* miles. to Aſtro. miles, and contrarily, as, 7 6:: ſo Aſtr. miles. to *Engl.* How meaſures in Feet of moſt Countries agree, you may find in the Table at the end of the Book, Entituled, *Forreign Meaſures and Weights compared with the Engliſh.* In all particular Maps you have a ſcale of miles to meaſure the diſtance of places, if thoſe places lye within the opening of the Compaſſes, if further,

ther, then by a Ruler turn the Compaſſes oftner about. The Globe of the Earth hath for its Superficies, Land and Sea, near the one equal to the other, the great Continents of *Europe*, *Aſia*, *Africk* and *America*, are called the *Firm Lands* or *Continents*; the reſt are *Iſlands* rounded by the Sea, *Peninſula*'s joyned only by a neck of Land to the greater, as the *Morea*, *&c.* *Iſthmus* that very neck, *Promontory* high ground that puts into the Sea.

Again, the Seas are divided into *Oceans* or Main Seas, and the *Mediterranium*, or Midland Sea. A *Gulf* is part of the Sea, almoſt cut off, as the *Baltick* Sea. A *Streight* is the part cut off, as the ſteights of *Gibraltar*, theſe are the General heads: And for a more particular practice, conſider *Figure* 21. wherein N. is the North Pole, S. the South Pole, EQ. part of the Equinoctial, A and B two places in the Northern Hemiſphere, D, C two in the Southern, AB, AC, and DC are part of great Circles paſſing betwixt thoſe ſeveral places; QB the Latitude of B, EA the Latitude of A, both North, FD and CQ the Lat. of D and C South. ∠ ANB = ∠ DSC is the Difference of Longitude, of A and B or D and C, the ∠s NAB and ABN ſhews the poſition, how one place lies from another: Therefore firſt, if two places lye in the ſame Meridian, both on the North ſide of the Equinoctial; as B and F: QB being the Lat. of B and QF of F, the difference of their Latitudes BF is their diſtance in degrees; if one lye on the Equinoctial, th'other not, as QB the Lat. of B. is the Diſtance, if one have N. Lat. th'other South as B and C, the ſumm of both their Latitudes is their Diſtance BC. All which, and ſome other varieties, as being both upon the Equinoctial, are eaſily underſtood upon the Scheme.

And

And for more Exact Rules to know the Distances, and positions of Places, consider the Triangle A N B. there is six parts in this oblique Spher. Δ. AN the Complement of the Latitude of A, N B the Complement of the Lat. of B, A B the Distance of A and B in a great Circle, ∠ A N B the Difference of Longitude of A and B, the ∠ N A B the position how B bears from A, from the Merid. towards the East, and the ∠ N B A how A bears from B towards the West. Any three parts of these six being given, to find any of the rest, use the Doctrine taught before in oblique Spher. Δ^s. if both the places be in South: Lat. as B C it is the same with the former, if one be North the other South resolve the Δ N A C. These Rules serve to find the distances and position of any two Stars after the same manner. The Δ C A B may by help of the former Rules be likewise resolv'd.

Lastly, to know how many square miles or perches there are in the whole Earth, or in any parcel or part thereof included in a Triangle, as A N B for the former, find how many square degrees there are on a Sphere, whose circumference of its greatest Circle is 360; say, by the Rules before taught; As, 7. 22 :: so square of 360 (= 129600.) to the superficies of the whole Sphere in square degrees 407314. and supposing sixty miles in a degree, there will be 3600 square miles in a square degree (though there be more in the Curve) which gives 1466330400 square miles in the whole; but to reduce these to *English* miles: say, Q. 6 = 36. Q. 7 = 49 :: so 1466330400. to 1077303966. *English* miles by the Back Rule.

But if it be a Spherical Triangle, as A N B, or any other, as A B C, and it be required to give the proportion of that Δ to the whole Sphere, according to Mr. *John Leak*'s Rule, demonstrated

monſtrated by Mr. *Foſter*, add all the Angles of the Spherical Triangle together, from which ſubduct 180 deg. divide the reſt by 720, it leaves the deg. and min. in proportion to 360 : : as that Triangle. to the Sphere.

Note III. Of *Navigation*, which teacheth how and by what means a ſhip may be directed on the Sea to the Place or deſired Port.

In ſhort Paſſages, where you are but a ſmall time without ſight of Land, the Compaſs and knowledge of the Land and Sea-marks are ſufficient : But in long Paſſages, where beſides the Compaſs, Lead and Log-line, there are required Inſtruments to take the Latitudes, and to enquire after the Longitude and Diſtances : You may conſider the ſame as one ſimple Courſe, or compounded of many : There are three wayes of performing both Courſes ; 1. By the *Plain Sea-chart* ; 2. By *Mercators-chart* ; or laſtly, by a *Great Circle*. The laſt is in part taught by the Rule in *Geography* laſt mentioned, of the diſtance and poſition of places, but is not practicable at Sea. The firſt may ſerve near the Equinoctial, but further off and in long Courſes is falſe ; the ſecond is true in all Courſes, and ought to be moſt practiſed ; the firſt and ſecond wayes are practiſed alike in plain Triangles, the Difference only, that the Meridians are not equally divided in *Mercators* way, but you muſt uſe the Table at the latter end of the Book, called, *A Table of Meridional Miles*, whereas in *Plain Sailing* all the lines are equally divided : the Practice will beſt appear by theſe few *Problems*.

Prob. I. To convert the *Rumbs* or points of the Compaſs into Degrees of Inclination towards the Meridian Line, and contrarily. The Mariners divide their Compaſs (which repreſenteth

ſenteth the Horizontal Circle) into 32 parts, called Rumbs; but far had it been better to have uſed 360 degrees, to have been accounted from both ends of the Merid. Line towards Eaſt and Weſt: but becauſe this Diviſion is not uſed take this Table, which will convert the points of the Compaſs into degrees and minutes of the ∠ of Inclination with the Meridian, and contrarily.

Theſe on this ſide the Weſt incline towards the N. end of the Mer.	*Angle of Incl. with the M. L.*	*Theſe on this ſide the Eaſt incline to the N. end of the Merid.*
Rumbs.	North.	Rumbs.
North by Weſt.	11°. 15'.	North by Eaſt.
N. N. Weſt.	22. 30.	N. N. Eaſt.
N. W. by N.	33. 45.	N. E. by N.
North Weſt.	45. 0.	North Eaſt.
N. W. by W.	56. 15.	N. E. by Eaſt.
W. N. W.	67. 30.	E. N. E.
W. by N.	78. 45.	E. by North.
Weſt.	90. 0.	Eaſt.
Weſt by South.	78. 45.	Eaſt by South.
W. S. W.	67. 30.	Eaſt S. Eaſt.
S. W. by W.	56. 15.	South E. by Eaſt.
South Weſt.	45. 0.	South Eaſt.
S. W. by S.	33. 45.	S. E. by S.
S. S. W.	22. 30.	S. S. Eaſt.
S. and by W.	11. 15.	S. by Eaſt.
Rumbs.	South.	Rumbs.
On this ſide Weſt incline towards S. end Meridian.		*Theſe on this ſide Eaſt incline to S. end Merid.*

If

If you account to quarter off points, add 2°. 48'. for one quarter: 5°. 37'. for two quarters, and 8°. 26'. for three quarters.

Prob. II. A ſhip ſailing under a great Circle, to know how many *Engliſh* miles anſwers the degrees: If it ſail directly N. and S. it is under the Merid. if E. and W. under the Equinoctial; ſay, 1 degree. give. 70 miles: : degrees gone. gives the *Engliſh* mile.

Prob. III. A ſhip ſailing under any Parallel, to know how many *Engliſh* miles anſwers to the number of degrees in that Parallel; ſay, as, Rad. ſico: Lat: of the Parallel: : ſo is number of the degrees in that parallel. To the number of great Circle degrees. which turned into miles gives the Anſwer.

Prob. IV. The *Rumb*, the *Diſtance* upon the Rumb in miles (60 to a degree) the *difference of Latitude* in miles, the *difference in Longitude* in miles, any two of theſe given, to find the other two: in a plain right ∠d Δ. (ſee *Fig.* 22.) Where A is the place from whence the ſhip ſails, the Rumb N E by N. therefore the Angle of Inclination BAC by the Table is 33. 45. its Complement BCA 56. 15. C the place to which the ſhip is to ſail, AC the diſtance in miles, 909 miles, AB is the difference in Long 853 miles; B is in Latitude 59°. 36' = A. C in Lat. 47°. therefore AC is 856 miles, this is according to the plain Sea Chart; but according to *Mercater*, you muſt find the diſtance AC by the Table of Meridional miles, thus, uſe the ſame directions given in the *Note* for Geography, the places being both on one ſide of the Equi. ſubſtract the Merid. miles anſwering 47°. *viz.* 3202 from the Merid. miles anſwering 59°. 36'. *viz.* 4480 reſt 1278 miles for the diſtance AC. This being the only difference in theſe two kinds of ſailing, and thus obſerved the Reſolution of this

A will perform all ſimple Courſes; and if it be compounded of many Courſes you muſt ſo many times multiply your Operation.

Note IV. Concerning Dyalling. To make an Horizontal Dial, you muſt calculate the diſtances on the Horizon from the Meridian to each hour, half hour and quarter by this Rule; As, Rad. to ſine of the Latitude : : ſo Tangent of the Equi. hour from Noon. to the Tangent of the Hor. Diſtance from the Meridian, of that hour, half or quarter.

If you deſire to calculate for every minute, then you take every minute of the Equi. hour, if for every quarter, then begin with 3°. 45′. 7°. 30′. 11. 15. and 15 for an hour, *&c.* To make a Dial for a full South Wall is the ſame with the former, only changing the ſine of the Latitude, to the Coſine.

For a Declining upright Plane, you muſt firſt find the Angle of the *Miridian and Subſtile* thus, as Rad. Co. tan. Lat : : ſine Declination. tang. ∠ deſired : ſecondly, the height of the Stile above the Subſtile; thus, as Rad. Coſi. Decl. : : Coſi. Lat. to the ſine of the height deſired: thirdly, the difference between the Merid. of the Plane and Place; as, ſi. Lat. to Rad. : : ſo tan. Decl. to Tang. deſired. Fourthly, and laſt you muſt find the Angles which the hour-lines make with the ſubſtile line, which is the Merid. of the Plane; as Rad. to ſi. of the ſtiles height above the Plane : : ſo is the tangent of the hour line from the Merid. of the Plane. to the tangent deſirrd. For a Merid. Dial, where the Plane looks full Eaſt or Weſt, the hour lines are all parallel to the line that paſſeth from Pole to Pole, which is the hour of ſix; then ſay, as Rad. to the height of the ſtyle in any known parts of a ſcale : : ſo is tangent of any hours diſtance from 6. To the diſtance thereof in the ſame parts.

Now

Now for a Mechanical way, to make any Dial, to any Plane, whether declining, reclining or inclining, crooked, bended, or any ways uneven, without any notice taking of any such declination, reclination, &c. by the help of a large and good Horizontal Dial, which must have a small hole in the Center to suffer a silk thred or hair to go through; you may work thus, under the Plane, where you intend to make a Dial draw a *Level Horizontal Line*, by any Carpenters or other Level, to this line set a scaffold or frame of any board or boards deep according to the bigness you intend the Dial to be; this scaffold must be level likewise.

This being fitted, and by any other true Dial, Equinoctial Ring, or by the height of the ☉, your minute Watch rectified or otherway, find the true time of the day, and placing your Horizontal Dial upon the level Plain, keeping it to the true time of the day, by removing it to and fro, you may by the thred from the Center, carried by the edge of the Gnomon, find out the Center of the new Dial, if it will have a Center which mark, and by small tacks fasten your Horizontal Dial in that place, that it may not move, the thred or hair carried by the edge of the Gnomon if continued into either Pole, and is the Gnomon to the new Dial, the perpendicular Line under it taken by a square is the substiler, and the stile may be fastned to the Plain, by help of that thred.

Now to draw the hour Lines, do this, lay the thred fixed to the Center of the Horizontal Dial, over the hour lines and quarters, and mark out in the Horizontal Line on the plain where they intersect,, Lines drawn from the Center of the new Dial to these points are the hour Lines: But some hour lines may run off the Plain, or by reason of the crookedness, or some Pillars

may hinder; to help this, draw as large a ſquare or oblong upon the Horizontal Plain as you may, and transfer (by help of the Center thred) all the hours from the Horizontal Dial into the Lines of the outſide of the ſaid ſquare or oblong; now if you bring a thred from the Center of the new Dial, and reſt it upon the hour points marked in the ſaid ſquare, the Center thred of the Horizontal Dial carried only to touch the other thred will deſcribe the hour line deſired, whether upon an even or uneven Plain that have Centers for the new Dial; but if the Line carried by the edge of the Gnomon of the Horizontal Dial will not meet with the Plain, as in all Eaſt and Weſt Plains much declining, then muſt you fix up a board or other matter to receive the Center by the ſide of the Plain, and then fixing a thred there by that, and the other thred you may ſtrike all the hour lines, as was before ſhewed in crooked Plains, and the thred from the Centers being the new Gnomon, muſt be fixed to the Wall by two ſtayes.

This may be practiſed with as much curioſity as any other, and will be ſure and exact.

Note V. The Deſcription and uſe of an *Univerſal Dial* for all Latitudes, being a Projection of the Sphere *in Plano*, preſented to his Royal Highneſs, *Anno* 1665. for his Particular uſe at Sea.

One *Hemiſphere* being circumſcribed by a Cylinder, wherein the Equinoctial and Cylinder touch, let the Hemiſphere be conceived ſo to extend from the Equinoctial, that the two colours, and all the Meridians may touch the Cylinder in the Tangents of the Degrees and Minutes of the Meridians, all the Meridians will be ſtreight Lines, all the Parallels Circles diſtant from one another as their Tangents; and for particular uſes, let the Hemiſphere have upon the

Interſection

Interſection of the Equinoctial Colure and Equinoctial, *Semicircles* at each degree diſtance.

Theſe, as likewiſe the Ecliptick, and all other Circles deſcribed from that point will be Ellipſes on the Cylinder: Having this Cylinder thus furniſhed, laying it upon a Plain, ſo that the Equinoctial Colure may touch the Plain, let this Cylinder be *Orthographically*, or *Perpendicularly* projected on that Plain: ſo have you the Dial or Hemiſphere now before you, the demonſtration whereof will be too tedious for this place. The deſcription thus; The point of ♈ and ♎ is the Center, the uppermoſt Line divided both wayes into 90 degrees is the Equinoctial, the Line ♈ o that goes at right Angles down is the ſemicircle of the Equinoctial Colure, the two edges are the Solſtitial Colures, and ſtand for the Meridian of 12 a Clock, all the ſtreight Lines from top to bottom are the Meridians or Hour Lines to every quarter of an hour, 15° of the Equinoctial above being an hour; the Meridians on both edges are numbred from the Equinoctial to the Pole, and from the Pole to the Equinoctial to 90°. The Parallels to the Equinox are drawn through every degree of the Meridian, and are ſo numbred both on the edges and on the middle being the Axis of the ſphere, upon the Quadrant on the left hand are drawn ſeveral Elliptical Lines, which repreſent the Circles formerly ſpoke of deſcribed upon the Center, being the point of Eaſt and Weſt to every two degrees. The Ecliptick is drawn both wayes from the Center ♈ and ♎ declining 23° 30′ upon the Merid. and divided into Signs and Degrees by thoſe Elliptick Lines.

The backſide of the Inſtrument has many Uſes ſhewed in the beginning of the Book: thoſe of this Projection follow.

Uſe 1. Having the ☉ place to find his Declination,

nation, right Aſcenſion, or by either of theſe to find the ☉ place.

Firſt, find by the day of the month on the back ſide the ☉ place, which ſeek in the Ecliptick, the Parallel that palleth by that place ſhewes the ☉ Declination, and the Meridian the ☉ right Aſcenſion in the Equinoctial; ſo likewiſe the Declination or right Aſcenſion given ſhews the ☉ place.

Uſe 2. To rectifie the Center Thred to ſhew any Horizon, or any Line of Eaſt or Weſt which paſſeth to the Zenith, or any Inclination to the Horizon or Equinoctial, that any point upon the Hemiſphere ſhall make with the Horizon. The Center Thred laid to the Latitude of the place on the left hand in Summer, or on the right hand in Winter will repreſent the Horizon of that Latitude by the greater figures which come numbred from the Pole. And if you lay it to the Latitude from the Equinoctial numbred by the ſmaller figures on the right hand in Summer, or left ſide in Winter, it repreſents the Line of Eaſt or Weſt, and the point in the Meridian ſhewes the Zenith. Or any point upon the face being ſet out by the Parallel and time of the day, laying the Center Thred thereto, it ſhewes on the edge how many degrees it inclines or declines to or from the Equinoctial, and that being added in all Northern Signs, or ſubſtracted in Southern to or from the Equinoctial height (which is alwayes = to the Complement of the Latitude) it gives the Inclination or Angle a great Circle paſſing by the point given, makes with the Horizon.

Uſe 3. To know the time of riſing and ſetting of the ☉ the Aſcenſional difference, the amplitude,

amplitude, and the length of the day or night.

By the laſt *Propoſition* lay the Center Thred to the Meridian for an Horizon, wherever the ⊙ parallel cuts it, amongſt the hour lines, it gives the ⊙ riſing and ſetting, and the Elliptical Line which paſſeth by that place gives the amplitude or the diſtance in degrees from the Eaſt; the Meridian of the ⊙ riſing carried to the Equinoctial ſhews the Aſcen. Diff. in degrees; laſtly, double the ⊙ ſetting for the length of the day, and riſing for night.

Uſe 4. To find what time the ⊙ will come Eaſt or Weſt, and what height the ⊙ ſhall have at that time. By the ſecond *Propoſition*, lay the Thred to the Latitude told from the Equinoctial in the edge on the contrary ſide to the Horizon, that is the Line of Eaſt and Weſt, and following the ⊙ parallel to that Line, the point where the interſection ſhall be amongſt the hours gives the time, and among the Ellipſes the ⊙ height at that time.

Uſe 5. To know the height of the ⊙ at ſix a clock and the Azimuth, or diſtance the ⊙ ſhall have from Eaſt or Weſt. Follow the ⊙ parallel to ſix a clock, the crooked lines ſhews you the ⊙ height; and laying the Center Thred to the point of Eaſt or Weſt, mark where the parallel cuts it, and follow the hour line to the Equinoctial (which now ſhall repreſent the Horizon) the diſtance from he Center is the Azimuth.

Uſe the 6. To find the ⊙ height at any time of the day: Setting the Horizon right find the point of the ⊙ riſing, ſetting one point of the Compaſſes there, extend the other to the Zenith, and by a black lead point make an Arch

that

that ſhall end upon the hour of the ☉ riſing, the Degrees of that Circle, cut by the hour lines ſhews the ☉ height.

Uſe 7. To rectifie the Hook, Bead and Plummet: At the end of the Hook (which by its skrew may be moved at liberty) there hangs a Thred and Plummet with a moveable Bead, the very end of the Hook from whence the Plummet hangs, muſt be skrew'd faſt to the place where the ☉ riſeth on the Horizon, and the Bead muſt be ſet to the Zenith on the contrary ſide.

Uſe 8. To find the hour of the day at any time the ☉ ſhining; after the Hook and Bead be rectified, as is ſet down in the laſt uſe, lift up the Inſtrument (ſo that the Bead and Plummet do freely play) that the ☉ may ſhine through the leaſt ſight upon the other, the Bead ſhews the time of the day amongſt the hour lines.

Uſe 9. By the ☉ height or hour to know the ☉ Azimuth. By the ſecond *Uſe*, obſerve where the Meridian of the ☉ hour and the Parallel meet, and thereby on the ſide find the Inclination of that point to the Horizon, where lay the Thred, then by *Uſe* 6. find the ☉ height, now let the Equinoctial repreſent the Horizon, and accounting the height amongſt the Parallels, where that Parallel croſſeth the Thred laid to the Inclination, follow the Meridian to the Equinoctial, the number from the Center is the Azimuth from the Eaſt.

Uſe. 10. All the former *Propoſitions* may be applyed to the Stars, remembring the ☉ ſhews the hour, therefore uſe the right Aſcenſion of the

the ☉ which take from the right Aſcenſion of the Star (if it be bigger, if not add 24 hours) reſts the time of that Stars coming to the Meridian; and if you know the Stars hour before midnight, take it from the time of the Stars Southing, if after add it you ſhall have the true ne of the night. Theſe excellent uſes you ave from this Inſtrument, ſold if you deſire it, with the Book: If you deſire it of Metal and Larger, Mr. *Marks* before mentioned will make them, or Mr. *Hayes* in *More-fields*. Laſtly, upon the inſide of the Cover you have a particular Dial will ſerve within Thirty miles from *London* preſently to know the hour of the day, the Parallels up and down anſwers the dayes of the month, the other ſtreight lines that are parallel, ſhews the ☉ height, and wherever that croſſeth the other, there is the hour, the long hours for Summer and ſhort ones for Winter, and placing a pin in the point *VI*, letting it ſhade in the Line *VI. IV.* a Line and Plummet playing from it will ſhew the ☉ height on the right ſide.

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§. 7. *Of the* Nature *and making of* Watches, Clocks *and other* Movements, *Collected from Mr.* Oughtreds Automata, *with ſeveral Additions and Notes about* Pendulums.

THe great Wheel whereon the Fuſie or ſtring with weights are fixed, divides the Nature of the Work in any *Movement*, that is, all the Wheels and Pinions from that to the Ballance or Fly only prepares the Motion, but the other way effect it. Things to be Noted are,

1. The

1. The Fuſie, and how many turns it hath.

2. The number and names of the Wheels, Teeth and Pinions, *viz.* in a Watch of four Wheels (ſuppoſing the Numbers annexed to be the Teeth) firſt the *Great Wheel* (Number 55 Teeth) turning the *Pinion* (Numb. 5) fixt to the *ſecond Wheel* (N. 45) turning the *Pinion* (N. 5.) fixt to the *Contrat Wheel* (N. 40) turning the *Pinion* (N. 5) fixt to the *Crown Wheel* (N. 17) having odd teeth, working upon the *Pallats* of the Ballance (N. 2) But in Watches of five Wheels there will be a third Wheel before the Contrat Wheele.

3. The *Pinion of Report* fixt to the Arbor of the great Wheel (N. 4) which lies hid betwixt the Plates in Watches, and turns the Hour Wheel (N. 36) which carries the hand about upon the Face divided into 12 or 24 hours.

For brevities ſake, let M. ſtand for the Movement whether Watch or Clock, F. the the Fuſie. A the great Wheel *a* the Pinion of report on its Arbor, E the ſecond wheel, *e* the Pinion on its Axis, I the Contrat wheel, *i* the Pinion on its Ax, O the Crown wheel carrying *o* its Pinion on its Axis. B the Dial wheel carrying the hand, in H hours, T time, *t* turns, N Notches or beats of the Ballance. Con. Continuance and length in time of the Watches going.

The Work will ſtand both in Letters and Figures, as in the *Example* :

a) B (*d* 4.) 36 (9
e) A (*f* 5.) 55. (11
i) E (*g* 5) 45. (9
o) I (*k* 5) 40 (8
O 17 Crown Wheel.
2 Pallats.

where

where every wheel is divided by the Pinion it moves from A to O. *viz.* 55 by 5 = 11 = *f.* 45 by 5 = 9 = *g.* 40 by 5 = 8 = *k.* But *B* divided by *a* gives 9 that is B by *a* = d.

1. *Rule.* f g k O 2 = 11 x 9 x 8 x 17 x 2 = 26928. equal to N. Notches or Beats made in one turn of the great Wheel, and 26928 x 9 = 242352 the beats that are made in one turn of the hand, whether 12 or 24. Laſtly, divide 242352 by 12 it gives the Beats in an hour, 20196, and by 60 gives the Beats in a minute, 336,6. Thus far I queſtion not, is very plain, and muſt be practiſed to be well underſtood, as being the foundation of the whole work; and by it you may eaſily know how many turns any Wheel or Pinion makes for one turn of the Fuſie, or hour wheel.

2. *Rule.* As the Beats for one turn of the great Wheel or Fuſie—— 26928
· Is to the Beats gone in one hour—— 20196
:: So continuance of the Watches going--- 16
· To the number of the turns about the Fuſie—— 12
:: And ſo are the hours of the Face—— 12
· To the Quotient of the hour Wheel divided by *a*.—— 9

Theſe proportions holding, that any three given, (not the ſame kind,) you may find the fourth: As for *Example*,

To know the continuance of the Watches going, that hath 12 turns in the Fuſie, and 26928 Beats in one turn; and 20196 Beats in an hour. Say, N in an H. N one t F :: 12 t of F. to Con. 20196) 26928 x 12 (16. But if it be demanded by the Beats, and the time of the Watches going to know the Turns of F.

26928) 20196 x 16 (12. Or if it be demanded what Quotient ſhall be laid upon the Pinion of Report; Say, 16. 12 : : 12. 9; or as 26928. 20196. Note that the leſſer B is taken, the longer ſhall be the continuance of the Watches going at an equal T.

Rule 3. Concerning *Pendulums*. The ſpring in a Watch, drawing harder at the firſt than at the laſt; and likewiſe in Clocks with weights and ſtrings, there is added the weight of the ſtring gotten every moment, to the Clock weight, and for that no Motion can by hand be made ſo fit, but there will come ſome unequalneſs, as you may hear by the Beats either of Watch or Clock, to juſten and regulate theſe inequalities *Monſieur Hugens* invented the way of applying *Pendulums* to either, for which his Name will be ever Remembred.

Pendulums, whoſe Vibrations are of the ſame Degrees and Minutes are equal, or if they riſe not above a Degree, and the ſquares of their Vibrations are in proportion to the lengths: For a Standard or Rule Monſieur *Hugens* gives the length of a *Pendulum* that ſhall ſwing ſeconds, to be 881 to the *Pariſian* feet 864. The *Engliſh* feet to the *Paris* feet by my Table are, As, 1000. 1068. Therefore, 864. 881 : : 1.068. 1.089, and 1.089 x 3 = 3,267 equal to three feet three inches, and two tenths of an inch.

The Honourable Lord *Bruncker*, and Maſter *Rock* found the length to be thirty nine inches and 525 parts, which a little exceeds the other, and may be, was juſtned by Maſter *Hugens*'s Rule for the Center of Oſcillation; for *Montons Pendulum* that ſhall vibrate one hundred thirty two times in a minute, it will be

be found likewiſe 8,1 inches agreeing to 39,2 inches *Engliſh* : Therefore for certain 39,2 inches may be called the univerſal meaſure, and relied on, to be the near length of a *Pendulum* that ſhall ſwing ſeconds each vibration : With this Caution and Rule : As the length of the ſtring from the point of ſuſpenſion to the Center of a round Ball. is to Radius : : ſo is Radius. to a fourth number. Let two fifths of that fourth be added to the former length, for the length of the *Pendulum*. Having this Standard, the next Rule is this : That the lengths of two *Pendulums* are in proportion to the ſquares of their ſeveral vibrations, which will be equal to the Beats of the Ballance; therefore the Beats that ſhall be propoſed in a minute, being given to be 50, and it be demanded to give the length of a *Pendulum*; Say, as the ſquare of 50. (2500) is to the ſquare of 60 (3600) : : ſo is 39,2. to 56,4 the length required for 2500) 3600 x 39,2 (56,4. And if the length be given to know the ſwings or beats in a minute. As Altitude given. To Altitude known : : ſo ſquare vibr: known. To ſquare vibr: req. whoſe ſquare root is the Anſwer : And becauſe the two middle terms ſtand in all ſuch Queſtions, and will be alwayes 141120 : Therefore divide 141120 by the ſquare of the ſwings in a minute, it gives the length ſought; or by the length it gives the ſquare of the ſwings. And thus as the Ingenious Maſter *Hook* firſt propoſed, I have hang'd a ſwing by my Clock to regulate it upon a Pin, that it may freely vibrate.

48) --- 4 (12
56 --- 7 (8
54 --- 6 (9
21

The numbers of the great wheel 56, its Pinion 4. turning the hour wheel 48. The great wheel turns a Pinion of 7 fixt to the Crown wheel 54, which turns a Pinion of 6 fixt to the Ballance wheel 21. The Quotients 8 x 9 x 21 x 2 = 3024 the beats in an hour, becauſe the great wheel turns once in an hour, elſe 12 x 9 x 21 x 2 = 36288. 12) 36288 (3024 and 60) 3024 (50,4 beats in a minute, and as was ſhewed before, the length of the *Pendulum* will be 55,5 inches, fix a weight upon a wire running into a rod, that ſhall have four feet 7,5 inches below the Pin whereon it playes, and about a foot or above, a wire beaten flat with ſeveral holes to fit to the top of this rod, and to a Pin placed upon the Ballance towards the back ſide, will regulate the Motion exceedingly well, and may be done without trouble or charge.

For the regulating the inequality of a ſwing, when it may riſe ſometimes higher, ſometimes lower: There are two wayes, either by making the Line play betwixt two Cheek parts of a Cycloid, as Monſieur *Hugens* has directed, which may eaſily be effected to any length of the *Pendulum*, and are made, if any deſire them, by Mr. *Humfrey Adamſon* near *Turn-ſtile* in *Holborn.*) Or elſe by not ſuffering the *Pendulum* to vibrate above an inch from its ſettlement: For my part, after ſome time and charge of Experiments, I believe the firſt the better way. Monſieur *Hugens* in his Book of *Pendulum* Clocks, propoſeth a Watch about a mans height, to go 30 hours, and to have theſe numbers. The great wheel 80, *&c.* which turns about

D B
6------72
2 30-30 2

A 80-8--- (10
E 48-8-- (6
I 48--- 24 (2
O 15

bout in an hour, and ſhews minutes; therefore for an hour multiply the Quotients. 10 x 6 x 2 x 15 x 2 = 3600 being the ſeconds in an hour (60 x 60 = 3600) or beats. Now the third wheel I turns about in one minute for 10 x 6 = 60, and carries a plate divided into 60 ſeconds, and ſhews the ſeconds; and upon the Arbor of the great wheel is fixed a wheel *a* turning another wheel *a*, both of 30 teeth, both turning about in an hour; the latter has on it a Pinion *b* of 6 teeth turning B 72 in 12 hours. This Watch has a pully tyed to its weight by which you may pull it up and not ſtop the Watch; the *Pendulum* playes betwixt two Cheeks, part of a Cycloid.

The next queſtion (ſuppoſing there be a ſcrew below or above the *Pendul.* to lift it up or let it down upon a ſqu. braſs Ruler divided into inc. and tenth parts) to know how many minutes and ſeconds every tenth part of an inch will make the Watch go faſter or ſlower in a day. I take the *Pendulum* which ſwings ſeconds length 39,2. Then by the Log. I make this Table.

I	II	III	IV	V
38. 7	1. 587711	1. 780988	60339	9. 21
38. 6	1. 588832	1. 780378	60331	7. 26
38. 9	1. 589949	1. 779819	60323	5. 31
39. 0	1. 591065	1. 779261	60315	3. 36
39. 1	1. 592177	1. 778705	60308	1. 55
39. 2	1. 592286	1. 778151	60.	1. 11
39. 3	1. 594393	1. 777597	59.92	1. 55
39. 4	1. 595496	1. 777046	59.85	3. 36
39. 5	1. 596597	1. 776495	59.77	5. 31
39. 6	1. 597695	1. 775996	59.70	7. 26
39. 7	1. 598790	1. 775399	59.62	9. 21

The first Column has in the middle the length of the *Pendulum* 39. 2 inches, upwards it diminisheth one tenth, and downwards increaseth one tenth.

The second Column are the Log. of the first.

The third Column are half of the Log. of the difference of the *II* taken out of the Log. 5.149588, which is of the standing number 141120 aforesaid: The *IV* Col. are the numbers of the *III*; and the *V* Column are the minutes and seconds that these augmentings or diminishings will cause in a day, and are gotten by Multiplying $24 \times 60 = 1440$ the minutes in a day, by the decimals above or under 60″. which work may be done easily to any length of a *Pendulum*.

Rule 4. Of finding out fit Numbers for the Wheels and Pinions.

1. Any two Fractions, whose terms are proportional performe the same Motion; as $\frac{9.\ 36.\ 45.\ 63}{1.\ 4\ \ 5\ \ 7}$ *&c.* The upper for the Wheel, the lower for the Pinion.

2. If it be as one Wheel. to one Pinion :: so is the product of many Wheels. to the product of many Pinions, both will perform the same Motion. *Exam.* $\frac{1440}{28}$ equal to $\frac{36}{28} \times \frac{8}{1} \times \frac{5}{1}$ or $\frac{26}{4} \times \frac{8}{7} \times \frac{50}{10}$ for $\frac{36 \times 8 \times 50}{4 \times 7 \times 10} = \frac{14400}{280} = \frac{1440}{28}$ nor matters it in what order the Wheels and Pinions are set, or which Pinion stand under every wheel.

3. These Factor's 36×8 given, may thus be varied, *viz.* Divide them by such numbers as will measure them, and multiply the Quotients by

by the Altern Diviſors, the Product of thoſe two laſt numbers ſhall be two to the Product of the Factor's given. for $36 \times 8 = 32 \times 9 = 288$.

9.	8
36.	8
4.	1
32.	9

4. If fit numbers cannot be had by any of the three former wayes, you muſt ſeek ſome Ratio as near as poſſible in this manner, as one of the two Numbers. is to the other : : ſo is 360. to a 4*th*. Divide that 4*th* number, and alſo 360, by 4, 5, 6, 7, 8, 9, 10, 12, 15; or which of them bringeth a Quotient neareſt to an Integer; as if the two Numbers be 147. 170, which are too great to be cut into wheels, and yet cannot be reduced into leſs, becauſe they have no greater common meaſure than Unity. Say therefore,

170. 147 : : 360. 311 4 6) 311 (52- 8) 311 (39-
147. 170 : : 360. 416 4) 360 (60) 360 (45.
8) 360 (45
416 (52

wherefore for the two Numbers 147 and 170, you may take 52 and 60; 39 and 45 or 45, and 52.

Rule 5. The Diameter or Circumference of any wheel being given in inches and one hundred parts, and the number of teeth it is divided into, to give the Diameter or Circumference of a leſſer Wheel or Pinion with a number of teeth given that ſhall exactly agree with the teeth of the greater Wheel : *Exam.* The great Wheel has one inch Diameter, and fifty teeth, the leſſer Wheel or Pinion ten teeth; ſay if 7. 22 : : 1. 3,14; then if 50. 3.14 : : 10. 63 for the Circumference of the Pinion, whoſe Diameter will be ,2 of an inch.

Rule 6. To give Numbers to a Watch that ſhall have a ſwift train, about 20000 beats in

an

an hour, that may have 12 turns about the Fuſie, and go 16 hours, and the number of the Crown Wheel 17. Say by the ſecond *Rule* 12. 16 :: 20000. 26666. the Beats for one turn of the Fuſie; and becauſe by the firſt *Rule* 26666 is equal to all the Quotients multiplyed together into 17 and into 2, that number being halv'd is 13333, and that again divided by 17 gives for the Quotient 784, which being broken into three numbers, that multiplyed together will be 784, or near to it; let them be 11. 9. 8. multiplyed are 792. Then $792 \times 17 \times 2 = 26928$; and ſay, 16. 12 :: 26928. 20196 the Beats in an hour. Alſo 16. 12 :: 12. 9 and $\frac{9}{1} = \frac{36}{4}$. Laſtly, by the three Quotients aſſured 11. 9. 8 find out the 3 Wheels and Pinions, by taking the Pinions as you deſire, as is done in the ſide: You may try ſeveral Experiments to make the Watch go longer by altering the Beats and Pinion of Report.

4) 36 (9
5) 55 (11
5) 45 (9
5) 40 (8
17
2

Examp. Of a Clock or Watch propoſed to go a week or eight dayes with this Order, that the Ballance wheel, or that which moves the *Pendulum* may go about in a minute, with an Index to ſhew ſeconds, that the great Wheel may go about in 12 hours, and that the wheel next it may go about in one hour to ſhew minutes: Firſt, how many ſeconds there are in 12 hours, and that $12 \times 60 \times 60 = 43200$ theſe are the Beats that ſhall be in one turn of the Great Wheel. Theſe are double, becauſe there are two ſwings to one tooth of the Ballance wheel, the half of 43200 is 21600, now the Ballance wheel muſt needs be 30, divide 21600 by it the Quotient is 720 to be broke into three Quotients, whereof the firſt muſt

muſt needs be 12 for the teeth of the great wheel, divide 720 by it, the Quotient is 60 for the two Quotients remaining, which may be either 10 and 6, or 5 and 12, or 8 and 7 $\frac{1}{2}$, which laſt let ſtand, then the work will ſtand thus, and the Pinions taken as you pleaſe to be all 8, the wheels muſt be 96. 64. 60. So then the great wheel will go about in twelve hours, the ſecond wheel in an hour, and the Ballance wheel in a minute, as deſired. I gave my Watch theſe Numbers to go above a year.

8) 96. (12
8) 64. (8
8) 60. (7 $\frac{1}{2}$

30
10-140
8--128
8-120
72

In my large Sphere going by clock work, there is a motion for the Revolution of the ☉ Apogeum writ down on the Circle to be made in 17096 years, but by Examining the Work I find it to be 17100, that is four years more. For the Great Wheel fixed is 96, a ſpindle wheel of 12 bars turns round it 8 times in 24 hours, that is in 3 hours; after theſe, there are four wheels, 20. 73, 24 and 75 wrought by endleſs ſcrews that are in value but one; therefore 3 x 20 x 73 x 24 x 75 = 7884000 hours, which divided by 24 gives 328500 dayes equal 900 years: Now on the laſt wheel 75 is a Pinion of 6, turning a great wheel that carries the Apogeum number 114, and 114 by 6 gives 19, and 900 x 19 = 17100.

Rule 7. Of giving particular Motions to any Movement. The number of a Motion, is the Proportion that it bears to one turn of the hour wheel, or the Pinion of Report, from whether ſoever it be taken, which proportion, being broken into two or three Quotients will ſhew the Wheels and Pinions, as if you took it for the Beats of the Ballance.

The

The laſt Note ſhall be concerning *Time*; that which is ordinarily termed the *Hour of the day*: Conſider this in the length of dayes, which are two, diſtinguiſhed only by the Revolution of the Earth: The firſt is the *Syderial Day*, where any fixt point or points of the Earth in the ſame Meridian or Azimuth returns from any Star to the ſame again; the ſecond the *Solar Day*, where the ſame Meridian of the Earth returns from the ☉ to the ſame again, neither of theſe dayes are the true Equinoctial day, indeed the *Syderial* is inſenſibly the ſame, if it be but for ſome ſmall ſpace of time, the difference being only ſome fourths and fifths of a degree ſlower in a day; but the *Solar* is notably longer than the other, *viz.* by 3′. 56″. 53‴. 19⁗ of time in a day, and from hence the length of an hour is generally accounted: Therefore to fit the *Pendulum* of a Watch or Clock to this Solar day and hour: *I.* By the *Revolution of a fixed Star* to the ſame point again after one or more Revolutions (which you muſt curiouſly obſerve by fixing your eye to a point.) If the *Motion* for one Revolution want 3′. 56″ of 24 hours, or for two, 7′. 43″, for three, 40′. 39′, *&c.* then doth your Watch go true to the Equal or Middle Motion of the ☉, if otherwiſe, the *Pendulum* muſt be altered to make it go ſo. *II.* By a *Sundial*, which though it be made never ſo exact, and your Motion ſo too, yet there will be a conſiderable difference after ſome dayes, nay even in one day, all which falls out by reaſon of the inequality of Natural Dayes, (which at laſt is ſetled and demonſtrated by Mr. *William Flamſted*, from whom (if God continue his health) Aſtronomy hopes for a better Dreſs; But this Manual will not admit the Table of Equations, which you may find in Monſieur *Hugens's*

Hugens's Horology, whereto you are referred.

Laſtly, there is added a *Table of the Right Aſcenſion of the* ☉, and a *Table of the Right Aſcenſion of the Stars* of the greater Magnitude, that when any of them comes into the Meridian, by ſubſtracting that of the ☉ from that of the Star (adding 24 hours, if need be) leaves the hour of the night.

And there is an *Excellent and uſeful Table* the laſt of all, of 22 *Stars*, which here never riſe or ſet, and are conſtantly ſeen, which Table ſhews their Right Aſcenſions, and their Time and Azimuth when they come under the *Pole Star*; therefore if you hang up a Thred and Plummet, and looking through a ſmall hole, (to take away the Stars ray) obſerve when any of theſe Stars come with the Pole *Star* to that Perpendicular; If you ſubſtract the ☉ Right Aſcenſion, from the hour of the Stars coming under the North Pole, you have the true time of the Night to a minute. Many other uſes may be made of this Table, but there is not room here to ſet them down.

The *Table of Right Aſcenſions* of the ☉ is very exact to a ſecond, to every degree of the Ecliptick; and becauſe the North-Signs have the ſame Right Aſcenſion with their Reſpective degrees of the South-ſigns 12 hours difference: the Table is contracted, and the common parts do anſwer two Columns: For finding the *Part proportional* for the ☉ minutes, the differences are ſet down to ſeconds, and may by ſupplyed from the Table of Parts Proportional, if you enter the 10 differences under 6, as you did for the Log. under 10.

The Table of the Right Aſcenſions and Declinations of one hundred of the Principal fixed Stars are rectified to the year 1680, and are taken from *Riccivlus* his laſt Book, Entituled *Aſtronomia*

Astronomia Reformata, are more exact than any other extant, and have their Differences set by, for every ten years to rectifie them, and were thus done at the desire of that Worthy and Able *Physitian*, and Incomparable *Mathematician*, Sir *Charles Scarbrough*, for the benefit of the Industrious Seaman.

The last Table of the Stars about the North-Pole, are Calculated for the Latitude of *London*, and for the year 1680. Any Artist may compute them for other Latitudes, observing that all such Stars whose Right Ascensions are above 9°. 14'. 10". and under 189°. 14'. 10". pass the Meridian before they come under the Pole-Star, all the other Semicircle contrary. This Table will be welcome to those that make Observations of the Stars, to know the true time of the night, and to rectifie their *Pendulum* Watches by: To all whom, let their Dayes and Nights be Fortunate.

Soli Deo Gloria.

A *Table* of *Logarithms*, from Unity to 10000, by which, and the Table of Proportional Parts annexed, the Logarithms of all Numbers under 100000 may easily be supplied.

N	*Log.*	N	*Log.*	N	*Log.*
1	000000	34	531479	67	826075
2	301030	35	544068	68	832509
3	477121	36	556302	69	838849
4	602060	37	568202	70	845098
5	698970	38	579783	71	851258
6	778151	39	591065	72	857332
7	845098	40	602060	73	863323
8	903090	41	612784	74	869232
9	954242	42	623249	75	875061
10	000000	43	633468	76	880814
11	041393	44	643453	77	886491
12	079181	45	653212	78	892095
13	113943	46	662758	79	897627
14	146128	47	672098	80	903089
15	176091	48	681241	81	908485
16	204120	49	690196	82	913814
17	230449	50	698970	83	919078
18	255272	51	707570	84	924279
19	278753	52	716003	85	929419
20	301030	53	724276	86	934498
21	322219	54	732394	87	939519
22	342422	55	740363	88	944483
23	361728	56	748188	89	949390
24	380211	57	755875	90	954242
25	397940	58	763428	91	959041
26	414973	59	770852	92	963788
27	431364	60	778151	93	968483
28	447158	61	785330	94	973128
29	462398	62	792392	95	977724
30	477121	63	799341	96	982272
31	491361	64	806180	97	986771
32	505150	65	812913	98	991226
33	518514	66	819544	99	995635

N	0	1	2	3	4
100	000000	000434	000868	001301	001734
101	004321	004751	005181	005609	006038
102	008600	009026	009451	009876	010299
103	012837	013259	013679	014100	014521
104	017033	017451	017868	018284	018700
105	021189	021603	022016	022428	022841
106	025306	025715	026125	026533	026942
107	029384	029789	030195	030599	031004
108	033424	033826	034227	034628	035029
109	037426	037825	038223	038620	039017
110	041393	041787	042182	042576	042969
111	045323	045714	046105	046495	046885
112	049218	049605	049993	050379	050766
113	053078	053466	053846	054229	054613
114	056905	057283	057666	058046	058426
115	060698	061075	061452	061829	062206
116	064458	064832	065206	065579	065953
117	068186	068557	068928	069298	069668
118	071882	072249	072617	072985	073352
119	075547	075912	076276	076640	077004
120	079181	079543	079904	080266	080626
121	082785	083144	083503	083861	084219
122	086359	086716	087071	087426	087781
123	089905	090258	090610	090963	091316
124	093422	093772	094122	094471	094820
125	096910	097257	097604	097951	098298
126	100371	100715	101059	101403	101747
127	103804	104146	104487	104828	105169
128	107209	107549	107888	108227	108565
129	110589	110926	111263	111599	111934
130	113943	114277	114611	114944	115278
131	117271	117603	117934	118265	118595
132	120574	120903	121231	121559	121888
133	123852	124178	124504	124830	125156
134	127105	127429	127753	128076	128399

5	6	7	8	9	D
002166	002598	003029	003461	003891	432
006466	006894	007321	007748	008174	428
010724	011147	011570	011993	012415	424
014940	015359	015779	016197	016616	419
019116	019532	019947	020361	020775	416
023252	023664	024075	024486	024896	412
027349	027757	028164	028571	028978	408
031408	031812	032216	032619	033021	404
035429	035829	036229	036629	037028	400
039414	039811	040207	040602	040998	396
043362	043755	044148	044539	044932	393
047275	047664	048053	048442	048830	389
051153	051538	051924	052309	052694	386
054996	055378	055760	056142	056524	382
058805	059186	059563	059942	060320	379
062582	062958	063333	063709	064083	376
066326	066699	067071	067443	067815	372
070038	070407	070776	071145	071514	369
073718	074085	074451	074816	075182	366
077368	077731	078094	078457	078819	363
080987	081347	081707	082967	082426	360
088576	084934	085291	085647	086004	357
088136	088490	088845	089198	089552	355
091667	092018	092369	092721	093071	351
095169	095518	095866	096215	096562	349
098644	098989	099335	099681	100026	346
102091	102434	102777	103119	103462	343
105510	105851	106191	106531	106871	340
108903	109241	109579	109916	110253	338
112269	112605	112939	113275	113609	335
115611	115943	116276	116608	116939	333
118926	119256	119586	119915	120245	330
122216	122544	122871	123198	123525	328
125481	125806	126131	126456	126781	325
128722	129045	129368	129689	130012	323

N	0	1	2	3	4
135	130334	130655	130977	131298	131619
136	133539	133858	134177	134496	134814
137	136721	137037	137354	137671	137987
138	139879	140194	140508	140822	141136
139	143015	143327	143639	143951	144263
140	146128	146438	146748	147058	147367
141	149219	149527	149835	150142	150449
142	152288	152594	152899	153205	153509
143	155336	155639	155943	156246	156549
144	158362	158664	158965	159266	159567
145	161368	161667	161967	162266	162564
146	164353	164650	164947	165244	165541
147	167317	167613	167908	168203	168497
148	170262	170555	170848	171141	171434
149	173186	173478	173769	174059	174351
150	176091	176381	176669	176959	177248
151	178977	179264	179552	179839	180126
152	181844	182129	182415	182699	182985
153	184691	184975	185259	185542	185825
154	187521	187803	188084	188366	188647
155	190332	190612	190892	191171	191451
156	193125	193403	193681	193959	194237
157	195899	196176	196453	196729	197005
158	198657	198932	199206	199481	199755
159	201397	201670	201943	202216	202488
160	204119	204391	204663	204934	205204
161	206826	207096	207365	207364	207904
162	209515	209783	210051	210319	210586
163	212187	212454	212720	212986	213252
164	214844	215109	215373	215638	215902
165	217484	217747	218010	218273	218536
166	220108	220369	220631	220892	221153
167	222716	222976	223236	223496	223755
168	225309	225568	225826	226084	226342
169	227887	228142	228400	228657	228913

5	6	7	8	9	D
131939	132259	132579	132899	133219	321
135133	135451	135769	136086	136403	318
138303	138618	138934	139249	139564	315
141449	141763	142076	142389	142702	314
144574	144885	145196	145507	145818	311
147676	147985	148294	148603	148911	309
150756	151063	151369	151676	151932	307
153815	154119	154423	154728	155032	305
156852	157154	157457	157759	158051	303
159863	160168	160469	160769	161068	301
162863	163161	163459	163758	164055	299
165838	166134	166430	166726	167022	297
168792	169086	169380	169674	169968	295
171726	172019	172311	172603	172895	293
174641	174932	175222	175512	175802	291
177536	177825	178113	178401	178689	289
180413	180699	180986	181272	181558	287
183269	183555	183839	184123	184407	285
186108	186391	186674	186956	187239	283
188928	189209	189490	189771	190051	281
191730	192009	192289	192567	192846	279
194514	194792	195069	195346	195623	278
197281	197556	197832	198107	198382	276
200029	200303	200577	200850	201124	274
202761	203033	203305	203577	203848	272
205475	205746	206016	206286	206556	271
208173	208441	208710	208978	209247	269
210853	211121	211388	211654	211921	267
213518	213783	214049	214314	214579	266
216166	216429	216694	216957	217221	264
218798	219060	219323	219585	219846	262
221414	221675	221936	222196	222456	261
224015	224274	224533	224791	225051	259
226599	226858	227115	227372	227629	258
229169	229426	229682	229938	230193	256

N	0	1	2	3	4
170	230449	230704	230959	231215	231469
171	232996	233250	233504	233757	234011
172	235528	235781	236033	236285	236537
133	238046	238297	238548	238799	239049
174	240549	240799	241048	241297	241546
175	243038	243286	243534	243782	244029
176	245513	245759	246006	246252	246499
177	247973	248219	248464	248709	248954
178	250420	250664	250908	251151	251395
179	252853	253096	253334	253580	253822
180	255273	255514	255755	255996	256237
181	257679	257918	258158	258398	258637
182	260071	260309	260548	260787	261025
183	262451	362688	262925	263162	263399
184	264818	265054	265289	265525	265761
185	267172	267406	267641	267875	268109
186	269513	269746	269979	270213	270446
187	271842	272074	272306	272538	272769
188	274158	274389	274619	274850	275081
189	276462	276692	276921	277151	277379
190	278754	278982	279211	279439	279667
191	281033	281261	281488	281714	281942
192	283301	283527	283753	283979	284205
193	285557	285782	286007	286232	286456
194	287802	288026	288249	288473	288696
195	290035	290257	290479	290702	290925
196	292256	292478	292699	292920	293141
197	294466	294686	294907	295127	295347
198	296665	296884	297104	297323	297542
199	298853	299071	299289	299507	299725
200	301029	301247	301464	301681	301898
201	303196	303412	303628	303844	304059
202	305351	305566	305781	305996	306211
203	307496	307709	307924	308137	308351
204	309630	309843	310056	310269	310481

5	6	7	8	9	D
231724	231979	232234	232488	232742	254
234264	234517	234770	235023	235276	253
236789	237041	237292	237544	237795	252
239299	239549	239799	240049	240299	250
241795	242044	242293	242541	242789	249
244277	244525	244772	245019	245266	248
246745	246991	247237	247482	247728	246
249198	249443	249687	249932	250176	245
251638	251881	252125	252368	252610	243
254064	254306	254548	254789	255031	242
256477	256718	256958	257198	257438	241
258877	259116	259355	259594	259833	239
261263	261501	261739	261976	262214	238
263366	263873	264109	264346	264582	237
265996	266232	266467	266702	266937	235
268344	268578	268812	269046	269279	234
270679	270912	271144	271377	271609	233
273001	273233	273464	273696	273927	232
275311	275542	275772	276002	276232	230
277609	277838	278067	278296	278525	229
279895	280123	280351	280578	280806	228
282169	282396	282622	282849	283075	227
284431	284656	284882	285107	285332	226
286681	286905	287129	287354	287578	225
288919	289143	289366	289589	289812	223
291147	291369	291591	291813	292034	222
293362	293584	293804	294025	294246	221
295567	295787	296007	296226	296446	220
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983	992554	992598	992642	992686	992730
984	992995	993039	993083	993127	993172
085	993436	993480	993524	993568	993613
986	993877	993921	993965	994009	994053
987	994317	994361	994405	994449	994493
988	994756	994801	994845	994889	994933
989	995196	995240	995284	995328	995372
990	995635	995679	995723	995764	995811
991	996074	996117	996161	996205	996249
992	996512	996555	996599	996643	996687
993	996949	996993	997037	997080	997124
994	997386	997430	997474	997517	997561
995	997823	997867	997910	997954	997998
996	998259	998303	998347	998390	998434
997	998695	998739	998783	998826	998869
998	999133	999174	999218	999261	999305
999	999565	999609	999652	999696	999739

End of the Table

5	6	7	8	9	D
989227	989272	989316	989361	989405	45
989672	989717	989761	989806	989850	44
990117	990161	990206	990250	990294	44
990561	990605	990649	990694	990738	44
991004	991049	991093	991137	991182	44
991448	991492	991536	991580	991625	44
991890	991935	991979	992023	992067	44
992333	992377	992421	992465	992509	44
992774	992819	992863	992907	992951	44
993216	993259	993304	993348	993392	44
993657	993701	993745	993789	993833	44
994097	994141	994185	994229	994273	44
994537	994581	994625	994669	994713	44
994977	995021	995065	995108	995152	44
995416	995459	995504	995547	995591	44
995854	995898	995942	995986	996029	44
996293	996337	996380	996424	996468	44
996731	996774	996818	996862	996906	44
997168	997212	997255	997290	997343	44
997605	997648	997692	997736	997779	44
998041	998085	998129	998172	998216	44
998477	998521	998564	998608	998652	44
998913	998956	998999	999043	999087	44
999348	999392	999435	999479	999522	44
999783	999826	999866	999913	999956	43

Of Logarithms.

Here followeth

A TABLE OF PARTS PROPORTIONAL,

FOR

The finding the Logarithms of all Numbers betwixt 10000 and 100000.

D	1	2	3	4	5	6	7	8	9
43	4	8	12	17	21	25	30	34	38
44	4	8	13	17	22	26	30	35	39
45	4	9	13	18	22	27	31	36	40
46	4	9	13	18	23	27	32	36	41
47	4	9	14	18	23	28	32	37	42
48	4	9	14	19	24	28	33	38	43
49	4	9	14	19	24	29	34	39	44
50	5	10	15	20	25	30	35	40	45
51	5	10	15	20	25	30	35	40	45
52	5	10	15	20	26	31	36	41	46
53	5	10	15	21	26	31	37	42	47
54	5	10	16	21	27	32	37	43	48
55	5	11	16	22	27	33	38	44	49
56	5	11	16	22	28	33	39	44	50
57	5	11	17	22	28	34	39	45	51
58	5	11	17	23	29	34	40	46	52
59	5	11	17	23	29	35	41	47	53
60	6	12	18	24	30	36	42	48	54
61	6	12	18	24	30	36	42	48	54
62	6	12	18	24	31	37	43	49	55
63	6	12	18	25	31	37	44	50	56
64	6	12	19	25	32	38	44	51	57
65	6	13	19	26	32	39	45	52	58
66	6	13	19	26	33	39	46	52	59
67	6	13	20	26	33	40	46	53	60
68	6	13	20	27	34	40	47	54	61
69	6	13	20	27	34	41	48	55	62
70	7	14	21	28	35	42	49	56	63
71	7	14	21	28	35	42	49	56	63
72	7	14	21	28	36	43	50	57	64
73	7	14	21	29	36	43	51	58	65
74	7	14	22	29	37	44	51	59	66
75	7	15	22	30	37	45	52	60	67
76	7	15	22	30	38	45	53	60	68

D	1	2	3	4	5	6	7	8	9
77	7	15	23	30	38	46	53	61	69
78	7	15	23	31	39	46	54	62	70
79	7	15	23	31	39	47	55	63	71
80	8	16	24	32	40	48	56	64	72
81	8	16	24	32	40	48	56	64	72
82	8	16	24	32	41	49	57	65	73
83	8	16	24	33	41	49	58	66	74
84	8	16	25	33	42	50	58	67	75
85	8	17	25	34	42	51	59	68	76
86	8	17	25	34	43	51	60	68	77
87	8	17	26	34	43	52	60	69	78
88	8	17	26	35	44	52	61	70	79
89	8	17	26	35	44	53	62	71	80
90	9	18	27	36	45	54	63	72	81
91	9	18	27	36	45	54	63	72	81
92	9	18	27	36	46	55	64	73	82
93	9	18	27	37	46	55	65	74	83
94	9	18	28	37	47	56	65	75	84
95	9	19	28	38	47	57	66	76	85
96	9	19	28	38	48	57	67	76	86
97	9	19	29	38	48	58	67	77	87
98	9	19	29	39	49	58	68	78	88
99	9	19	29	39	49	59	69	79	89
00	10	20	30	40	50	60	70	80	90
01	10	20	30	40	50	60	70	80	90
02	10	20	30	40	51	61	71	81	91
03	10	20	30	41	51	61	72	82	92
04	10	20	31	41	52	62	72	83	93
05	10	21	31	42	52	63	73	84	94
06	10	21	31	42	53	63	74	84	95
07	10	21	32	42	53	64	74	85	96
08	10	21	32	43	54	64	75	86	97
09	10	21	32	43	54	65	76	87	98
10	11	22	33	44	55	66	77	88	99

D	1	2	3	4	5	6	7	8	9
111	11	22	33	44	55	66	77	88	99
112	11	22	33	44	56	67	78	89	100
113	11	22	33	45	57	67	78	90	101
114	11	22	34	45	57	68	79	91	102
115	11	23	34	46	57	69	80	92	103
116	11	23	34	46	58	69	81	92	104
117	11	23	35	46	58	70	81	93	105
118	11	23	35	47	59	70	82	94	106
119	11	23	35	47	59	71	83	95	107
120	12	24	36	48	60	72	84	96	108
121	12	24	36	48	60	72	84	96	109
122	12	24	36	48	61	73	85	97	110
123	12	24	36	48	61	73	86	98	111
124	12	24	37	49	62	74	86	99	112
125	12	25	37	50	62	75	87	100	113
126	12	25	37	50	63	75	88	100	114
127	12	25	38	50	63	76	88	101	115
128	12	25	38	51	64	76	89	102	116
129	12	25	38	51	64	77	90	103	117
130	13	26	39	52	65	78	91	104	118
131	13	26	49	52	65	78	91	104	119
132	13	26	49	52	66	79	92	105	120
133	13	26	49	53	66	79	93	106	121
134	13	26	40	53	67	80	93	107	122
135	13	27	40	54	67	81	94	108	123
136	13	27	40	54	68	81	95	108	124
137	13	27	41	54	68	82	95	109	125
138	13	27	41	55	69	82	96	110	126
139	13	27	41	55	69	83	97	111	127
140	14	28	42	56	70	84	95	112	128
141	14	28	42	56	70	84	98	112	129
142	14	28	42	56	71	85	99	113	128
143	14	28	42	57	71	85	100	114	129
144	14	28	43	57	72	86	100	115	129

D	1	2	3	4	5	6	7	8	9
145	14	28	43	58	72	87	101	116	130
146	14	29	43	58	73	87	102	116	131
147	14	29	44	58	73	88	102	117	132
148	14	29	44	59	74	88	103	118	133
149	14	29	44	59	74	89	104	119	134
150	15	30	45	60	75	90	105	120	135
151	15	30	45	60	75	90	105	120	135
152	15	30	45	60	76	91	106	121	136
153	15	30	45	60	76	91	107	122	137
154	15	30	46	61	77	92	107	123	138
155	15	31	46	62	77	93	108	124	139
156	15	31	46	62	78	93	109	124	140
157	15	31	47	62	78	94	109	125	141
158	15	31	47	63	79	94	110	126	142
159	15	31	47	63	79	95	111	127	143
160	16	32	48	64	80	96	112	128	144
161	16	32	48	64	80	96	112	128	344
162	16	32	48	64	81	97	113	129	145
163	16	32	48	65	82	98	114	130	146
164	16	32	49	66	82	98	114	131	147
165	16	33	49	66	82	99	115	132	148
166	16	33	49	66	83	99	116	132	149
167	16	33	50	66	83	100	116	133	150
168	16	33	50	67	84	100	117	134	151
169	16	33	50	67	84	101	118	135	152
170	17	34	51	68	85	102	119	136	153
171	17	34	51	68	85	102	119	136	153
172	17	34	51	68	86	103	120	137	154
173	17	34	51	69	86	103	121	138	155
174	17	34	52	69	87	104	121	139	156
175	17	34	52	70	87	105	122	140	157
176	17	35	52	70	88	105	123	140	158
177	17	35	53	70	88	106	123	141	159
178	17	35	53	71	89	106	124	142	160

D	1	2	3	4	5	6	7	8	9
179	17	35	53	71	89	107	125	143	161
180	18	36	54	72	90	108	126	144	162
281	18	36	54	72	90	108	126	144	162
182	18	36	54	72	91	109	127	145	163
183	18	36	54	73	91	109	128	146	164
184	18	36	55	73	92	110	128	147	165
185	18	37	55	74	92	111	129	148	166
186	18	37	55	74	93	111	130	148	167
187	18	37	56	74	93	112	130	149	168
188	18	37	56	75	94	112	131	150	169
189	18	37	56	75	94	113	132	151	170
190	19	38	57	76	95	114	133	152	171
191	19	38	57	76	95	114	133	152	171
192	19	38	57	76	96	115	134	153	172
193	19	38	57	77	96	115	135	154	173
194	19	38	58	77	97	116	135	155	174
195	19	39	58	78	97	117	136	156	175
196	19	39	59	78	98	117	136	156	176
197	19	39	59	78	98	118	137	157	177
198	19	39	59	79	99	118	138	158	178
199	19	39	59	79	99	119	139	159	179
200	20	40	60	80	100	120	140	160	180
201	20	40	60	80	100	120	140	160	180
202	20	40	60	80	101	121	141	161	181
203	20	40	60	81	101	121	142	162	182
204	20	40	61	81	102	122	142	163	183
205	20	41	61	82	102	123	143	164	184
206	20	41	61	82	103	123	144	164	185
207	20	41	62	82	103	124	244	165	186
208	20	41	62	83	104	124	145	166	187
209	20	41	62	83	104	125	146	167	188
210	21	42	63	84	105	126	147	168	189
211	21	42	63	84	105	126	147	168	189
212	21	42	63	84	106	127	148	169	190

D	1	2	3	4	5	6	7	8	9
213	21	42	63	85	106	127	149	170	191
214	21	42	64	85	107	128	149	171	192
215	21	43	64	86	107	129	150	672	193
216	21	43	64	86	108	129	151	172	194
217	21	43	65	86	108	130	151	173	195
218	21	43	65	87	109	130	152	174	196
219	21	43	65	87	109	131	153	175	197
220	22	44	66	88	110	132	154	166	19.
221	22	44	66	88	110	132	154	176	198
222	22	44	66	88	111	133	155	177	199
223	22	44	66	89	111	133	156	178	200
224	22	44	67	89	112	134	156	179	201
225	22	45	67	90	112	135	157	180	202
226	22	45	67	90	113	135	158	180	203
227	22	45	68	90	113	136	158	181	204
228	22	45	68	91	114	136	159	182	205
229	22	45	68	91	114	137	160	183	206
230	23	46	69	92	115	138	161	284	207
231	23	46	69	92	115	138	161	184	207
232	23	46	69	92	116	139	162	185	208
233	23	46	69	93	116	139	163	186	209
234	23	46	70	93	117	140	163	187	210
235	23	47	70	94	117	141	164	188	211
236	23	47	70	94	118	141	165	188	212
237	23	47	71	94	118	142	165	189	213
238	23	47	71	95	119	142	166	190	214
239	23	47	71	95	119	143	167	191	215
240	24	48	72	96	120	144	168	192	216
241	24	48	72	96	120	144	168	192	216
242	24	48	72	96	121	145	169	193	217
243	24	48	72	97	121	145	170	194	218
244	24	48	73	97	122	146	170	195	219
245	24	49	73	98	122	147	171	196	220
246	24	49	73	98	123	147	172	196	221

D	1	2	3	4	5	6	7	8	
247	24	49	74	98	123	148	172	197	22
248	24	49	74	99	124	148	173	198	22
249	24	49	74	99	124	149	174	199	22
250	25	50	75	100	125	150	175	200	22
251	25	50	75	100	125	150	175	200	22
252	25	50	75	100	126	151	176	201	22
253	25	50	75	101	126	151	177	202	22
254	25	50	76	101	127	152	177	203	22
255	25	50	76	102	127	153	178	204	22
256	25	51	76	102	128	153	179	204	23
257	25	51	77	102	128	154	179	205	23
258	25	51	77	103	129	154	180	206	23
259	25	51	77	103	129	155	181	207	23
260	26	52	78	104	130	156	182	208	23
261	26	52	78	104	130	156	182	208	23
262	26	52	78	104	131	156	183	209	23
263	26	52	78	105	131	157	184	210	23
264	26	52	79	105	132	158	184	211	23
265	26	53	79	106	132	159	185	212	23
266	26	53	79	106	133	159	186	212	23
267	26	53	80	106	133	160	186	213	24
268	26	53	80	107	134	160	187	214	24
269	26	53	80	107	134	161	188	215	24
270	27	54	81	108	135	162	189	216	24
271	27	54	81	108	135	162	189	216	24
272	27	54	81	108	136	163	190	217	24
273	27	54	81	109	136	163	191	218	24
274	27	54	82	109	137	164	191	219	24
275	27	55	82	110	137	165	192	220	24
276	27	55	82	110	138	165	193	220	24
277	27	55	83	110	138	166	193	221	24
278	27	55	83	111	139	166	194	222	25
279	27	55	83	111	139	167	195	223	25
280	28	56	84	112	140	168	196	224	25

D	1	2	3	4	5	6	7	8	9
81	28	56	84	112	140	168	196	224	252
82	28	56	84	112	141	169	197	225	253
83	28	56	84	113	141	169	198	226	254
84	28	56	85	113	142	170	198	227	255
85	28	57	85	114	142	171	199	228	256
86	28	57	85	114	143	171	200	228	257
87	28	57	86	114	143	172	200	229	258
88	28	57	86	115	144	172	201	230	259
89	28	57	86	115	144	173	202	231	260
90	29	58	87	116	145	174	203	232	261
91	29	58	87	116	145	174	203	232	261
92	29	58	87	116	146	175	204	233	262
93	29	58	87	117	146	175	205	234	263
94	29	58	88	117	147	176	205	235	264
95	29	59	88	118	147	177	206	236	265
96	29	59	88	118	148	177	207	236	266
97	29	59	88	118	148	178	207	237	267
98	29	59	89	119	149	178	208	238	268
99	29	59	89	119	149	179	209	239	269
00	30	60	90	120	150	180	210	240	270
01	30	60	90	120	150	180	210	240	270
02	30	60	90	120	151	181	211	241	271
03	30	60	90	121	151	181	212	242	272
04	30	60	91	121	152	182	212	243	273
05	30	61	91	122	152	183	213	244	274
06	30	61	91	122	153	183	214	244	275
07	30	61	92	122	153	184	214	245	276
08	30	61	92	123	154	184	215	246	277
09	30	61	92	123	154	185	216	247	278
10	31	62	93	124	155	186	217	248	279
11	31	62	93	124	155	186	217	248	279
12	31	62	93	124	156	187	218	249	280
13	31	62	93	125	156	187	219	250	281
14	31	62	94	125	157	188	219	251	282

D	1	2	3	4	5	6	7	8	9
315	31	63	94	126	157	189	220	252	28
316	31	63	94	126	158	189	221	252	28
317	31	63	95	126	158	190	221	253	28
318	31	63	95	127	159	190	222	254	28
319	31	63	95	127	159	191	223	255	28
320	32	64	96	128	160	192	224	256	28
321	32	64	96	128	160	192	224	256	28
322	32	64	96	128	161	193	225	257	28
323	32	64	96	129	161	193	226	258	29
324	32	64	97	129	162	194	226	259	29
325	32	65	97	130	162	195	227	260	29
326	32	65	97	130	163	195	228	260	29
327	32	65	98	130	163	196	228	261	29
328	32	65	98	131	163	196	229	262	29
329	32	65	98	131	164	197	230	263	29
330	33	66	99	132	165	198	231	264	29
331	33	66	99	132	165	198	231	264	29
332	33	66	99	132	166	199	232	265	29
333	33	66	99	133	166	199	233	266	29
334	33	66	100	133	167	200	233	267	30
335	33	67	100	134	167	201	234	268	30
336	33	67	100	134	968	201	235	268	30
337	33	67	101	134	168	202	235	269	30
338	33	67	101	135	169	202	236	270	30
339	33	67	101	135	169	203	237	271	30
340	34	68	102	136	170	204	238	272	30
341	34	68	102	136	170	204	238	272	30
342	34	68	102	136	171	205	239	273	30
343	34	68	102	137	171	205	240	274	30
344	34	68	103	137	172	206	240	275	30
345	34	69	103	138	172	207	241	276	31
346	34	69	103	138	173	207	242	276	31
347	34	69	104	138	173	208	242	277	31
348	34	69	104	139	174	208	243	278	31

D	1	2	3	4	5	6	7	8	9
49	34	69	104	139	174	209	244	279	314
50	34	70	105	140	175	210	245	280	315
51	35	70	105	140	175	210	245	280	315
52	35	70	105	140	176	211	246	281	316
53	35	70	105	141	176	211	247	282	317
54	35	70	106	141	177	212	247	283	318
55	35	71	106	142	177	213	248	284	319
56	35	71	106	142	178	213	249	284	320
57	35	71	107	142	178	214	249	285	321
58	35	71	107	143	179	214	250	286	322
59	35	71	107	143	179	215	251	287	323
60	36	72	108	144	180	216	252	288	324
61	36	72	108	144	180	216	252	288	324
62	36	72	108	144	181	217	253	289	325
63	36	72	108	145	181	217	254	290	326
64	36	72	109	145	182	218	254	291	327
65	36	73	109	146	182	219	255	292	328
66	36	73	109	146	182	219	256	292	329
67	36	73	110	146	183	220	256	293	330
68	36	73	110	147	184	220	257	294	331
69	36	73	110	147	184	221	258	295	332
70	37	74	111	148	185	222	259	296	333
71	37	74	111	148	185	222	259	296	333
72	37	74	111	148	186	223	260	297	334
73	37	74	111	149	186	223	261	298	335
74	37	74	112	149	187	224	261	299	336
75	37	75	112	150	187	225	262	300	337
76	37	75	112	150	188	225	263	300	338
77	37	75	113	150	188	226	263	301	339
78	37	75	113	151	189	226	264	302	340
79	37	75	113	151	189	227	265	303	341
80	38	76	114	152	190	228	266	304	342
81	38	76	114	152	190	228	266	304	342
82	38	76	114	152	191	229	267	305	343

D	1	2	3	4	5	6	7	8	9
383	38	76	114	153	191	229	268	306	344
384	38	76	115	153	192	230	268	307	345
385	38	77	115	154	192	231	269	308	346
386	38	77	115	154	193	231	270	308	347
387	38	77	116	154	193	232	270	309	348
388	38	77	116	155	194	232	271	310	349
389	38	77	116	155	194	233	272	311	350
390	39	78	117	156	195	233	273	312	351
391	39	78	117	156	195	233	273	312	351
392	39	78	117	156	196	234	274	313	352
393	39	78	117	157	196	235	275	314	353
394	39	78	118	157	197	236	275	315	354
395	39	79	118	158	197	237	276	316	355
396	39	79	118	158	198	237	277	316	356
397	39	79	119	158	198	238	277	317	357
398	39	79	119	159	199	238	278	318	358
399	39	79	119	159	199	239	279	319	359
400	40	80	120	160	200	240	280	320	360
401	40	80	120	160	200	240	280	320	360
402	40	80	120	160	201	241	281	321	361
403	40	80	120	161	201	241	282	322	362
404	40	80	121	161	202	242	282	323	363
405	40	81	121	162	202	243	283	324	364
406	40	81	121	162	203	243	284	324	365
407	40	81	122	162	203	244	284	325	366
408	40	81	122	163	204	244	285	326	367
409	40	81	122	163	204	245	286	327	368
410	41	82	123	164	205	246	287	328	369
411	41	82	123	164	205	246	287	328	369
412	41	82	123	164	206	247	288	329	370
413	41	82	123	165	206	247	289	330	371
414	41	82	124	165	207	248	289	331	372
415	41	82	124	166	207	249	290	332	373
416	41	83	124	166	208	249	291	332	374

D	1	2	3	4	5	6	7	8	9
417	41	83	125	166	208	250	291	333	375
418	41	83	125	167	209	250	292	334	376
419	41	83	125	167	209	251	293	335	377
420	42	84	126	168	210	252	294	336	378
421	42	84	126	168	210	252	294	336	378
422	42	84	126	168	211	253	295	337	379
423	42	84	126	169	211	253	296	338	380
424	42	84	127	169	212	254	296	339	381
425	42	85	127	170	212	355	297	340	382
426	42	85	127	170	213	255	298	340	383
427	42	85	128	170	213	256	298	341	384
428	42	85	128	171	214	256	299	342	385
429	42	85	128	171	214	257	300	343	386
430	43	86	129	172	215	258	301	344	387
431	43	86	129	172	215	258	301	344	387
432	43	86	129	172	216	259	302	345	388
433	43	86	129	173	216	259	303	346	389
434	43	86	130	173	217	260	304	347	390
435	43	87	130	174	217	261	304	348	391

Here followeth

A TABLE

OF

Artificial Sines & Tangents,

For every Degree and ten Minutes of the Quadrant.

	L. Sine.		L. Tang.	
0	0.000000	10.00000	6.463726	13.536274
10	7.463726	9.999998	7.463727	12.536273
20	7.764754	9.999993	7.764761	12.235239
30	7.940842	9.999983	7.940858	12.059142
40	8.065776	9.999971	8.065806	11.934194
50	8.162681	9.999954	8.162737	11.837273
1	8.241855	9.999934	8.241921	11.758079
10	8.308794	9.999910	8.308884	11.691116
20	8.366777	9.999882	8.366895	11.633105
30	8.417919	9.999851	8.418068	11.581932
40	8.463665	9.999816	8.463849	11.536151
50	8.505045	9.999778	8.505267	11.494733
2	8.542819	9.999735	8.543084	11.456916
10	8.577566	9.999689	8.577877	11.422123
20	8.609734	9.999640	8.610094	11.389906
30	8.639679	9.999586	8.640093	11.359907
40	8.667689	9.999529	8.668160	11.331840
50	8.693998	9.999469	8.694529	11.305471
3	8.718800	9.999404	8.719396	11.280604
10	8.742259	9.999336	8.742922	11.257078
20	8.764511	9.999265	8.765246	11.234754
30	8.785675	9.999189	8.786486	11.213514
40	8.805852	9.999110	8.806742	11.193258
50	8.825130	9.999027	8.826103	11.173897
4	8.843585	9.998941	8.844644	11.155356
10	8.861283	9.998851	8.862433	11.137567
20	8.878285	9.998757	8.879529	11.120471
30	8.894643	9.998659	8.895984	11.104016
40	8.910404	9.998558	8.911846	11.088154
50	8.925609	9.998453	8.927156	11.072844
		L. Sine.		L. Tang.

	L. Sine		L. Tang.		
	8.940296	9.998344	8.941952	11.058048	85
10	8.954499	9.998232	8.956267	11.043733	50
20	8.968249	9.998116	8.970133	11.029867	40
30	8.981573	9.997996	8.983577	11.016423	30
40	8.994497	9.997873	8.996624	11.003376	20
50	9.007044	9.997732	9.009298	10.990702	10
	9.019235	9.997614	9.021620	10.978380	84
10	9.031089	9.997480	9.033609	10.966391	50
20	9.042625	9.997341	9.045284	10.954716	40
30	9.053859	9.997199	9.056660	10.943340	30
40	9.064806	9.997053	9.067752	10.932248	20
50	9.075480	9.996904	9.078576	10.921424	10
	9.085894	9.996751	9.089144	10.910856	83
10	9.096062	9.996594	9.099468	10.900532	50
20	9.105992	9.996433	9.109559	10.890441	40
30	9.115698	9.996269	9.119429	10.880571	30
40	9.125187	9.996100	9.129087	10.870913	20
50	9.134470	9.995928	9.138542	10.861458	10
	9.143555	9.995753	9.147803	10.852197	82
10	9.152451	9.995573	9.156877	10.843123	50
20	9.161164	9.995390	9.165773	10.834226	40
30	9.169702	9.995203	9.174499	10.825501	30
40	9.178072	9.995012	9.183060	10.816940	20
50	9.186280	9.994818	9.191462	10.808538	10
	9.194332	9.994620	9.199712	10.800287	81
10	9.202234	9.994418	9.207817	10.792183	50
20	9.209992	9.994212	9.215780	10.784220	40
30	9.217609	9.994003	9.223607	10.776393	30
40	9.225092	9.993789	9.231302	10.768698	20
50	9.232444	9.993572	9.238872	10.761128	10
		L. Sine.		L. Tang.	

	L. Sine.		L Tang.		
10	9.239670	9.993351	9.246319	10.753681	8
10	9.246775	9.993127	9.253648	10.746352	5
20	9.253761	9.992898	9.260863	10.739137	4
30	9.260633	9.992666	9.267967	10.732033	3
40	9.267395	9.992430	9.274964	10.725036	2
50	9.274049	9.992190	9.281858	10.718142	1
11	9.280599	9.991947	9.288652	10.711348	7
10	9.287048	9.991699	9.295349	10.704651	5
20	9.293399	9.991448	9.301951	10.698049	4
30	9.299655	9.991193	9.308463	10.691537	3
40	9.305819	9.990934	9.314885	10.685115	2
50	9.311893	9.990671	9.321222	10.678778	1
12	9.317879	9.990404	9.327475	10.672525	7
10	9.323780	9.990134	9.333646	10.666354	5
20	9.329599	9.989860	9.339739	10.660261	4
30	9.335337	9.989581	9.345755	10.654245	3
40	9.340996	9.989299	9.351697	10.648303	2
50	9.346579	9.989014	9.357566	10.642434	1
13	9.352088	9.988724	9.363364	10.636636	7
10	9.357524	9.988430	9.369094	10.630906	5
20	9.362889	9.988133	9.374756	10.625244	4
30	9.368185	9.987832	9.380354	10.619646	3
40	9.373414	9.987526	9.385888	10.614112	2
50	9.378577	9.987217	9.391360	10.608640	1
14	9.383675	9.986904	9.396771	10.603229	7
10	9.388711	9.986587	9.402124	10.597876	5
20	9.393685	9.986266	9.407419	10.592581	4
30	9.398600	9.985942	9.412658	10.587342	3
40	9.403455	9.985613	9.417842	10.582157	2
50	9.408254	9.985280	9.422973	10.577026	1
		L. Sine.		L. Tang.	

	L. Sine.		L. Tang.		
	9.412996	9.984943	9.428052	10.571847	75
0	9.417684	9.984603	9.433080	10.566920	50
0	9.422317	9.984259	9.438059	10.561941	40
0	9.426899	9.983910	9.442988	10.557011	30
0	9.431429	9.983558	9.447870	10.552129	20
0	9.435918	9.983202	9.452706	10.547294	10
	9.440338	9.982842	9.457496	10.542503	74
0	9.444720	9.982477	9.462242	10.537758	50
0	9.449054	9.982109	9.466945	10.533055	40
0	9.453342	9.981737	9.471605	10.528395	30
0	9.457584	9.981361	9.476223	10.523777	20
0	9.461782	9.980980	9.480801	10.519199	10
7	9.465935	9.980596	9.485339	10.514661	73
0	9.460446	9.980208	9.489838	10.510162	50
0	9.474115	9.979816	9.494299	10.505701	40
0	9.478142	9.979419	9.498722	10.501278	30
0	9.482128	9.979019	9.503109	10.496891	20
0	9.486075	9.978615	9.507459	10.492540	10
8	9.489982	9.978206	9.511776	10.488225	72
10	9.493851	9.977794	9.516057	10.483942	50
20	9.497682	9.977377	9.520305	10.489695	40
30	9.501476	9.977956	9.524520	10.475480	30
40	9.505234	9.976532	9.528702	10.471298	20
50	9.508955	9.976103	9.532852	10.467247	10
9	9.512642	9.975670	9.536972	10.463028	71
10	9.516294	9.975233	9.541061	10.458939	50
20	9.519911	9.974792	9.545119	10.454881	40
30	9.523495	9.974346	9.549149	10.450851	30
40	9.527046	9.973897	9.553149	10.446851	20
50	9.530565	9.973443	9.557121	10.442879	10
		L. Sine.		L. Tang.	

	L. Sine.		L. Tang		
20	9.534052	9.972986	9.561066	10.438934	7
10	9.537507	9.972524	9.564983	10.435017	5
20	9.540931	9.972058	9.569873	10.431126	4
30	9.544325	9.971588	9.572738	10.427262	3
40	9.547689	9.971112	9.576576	10.423424	2
50	9.551024	9.970634	9.580389	10.419611	1
21	9.554329	9.970152	9.584177	10.415823	6
10	9.557606	9.969665	9.587941	10.412059	5
20	9.560855	9.969173	9.591681	10.408319	4
30	9.564075	9.968678	9.595397	10.404602	3
40	9.567269	9.968178	9.599091	10.400909	2
50	9.570435	9.967674	9.602761	10.397239	1
22	9.573575	9.967166	9.606409	10.393590	6
10	9.576689	9.966653	9.600036	10.399964	5
20	9.579777	9.966136	9.613641	10.386359	4
30	9.582840	9.965615	9.617224	10.382776	3
40	9.585877	9.965090	9.620787	10.379213	2
50	9.588890	9.964560	9.624330	10.375670	1
23	9.591878	9.964026	9.627852	10.372148	6
10	9.594842	9.963488	9.631354	10.368645	5
20	9.597783	9.962945	9.634838	10.365162	4
30	9.600700	9.962398	9.638302	10.361698	3
40	9.603594	9.961846	9.641747	10.358253	2
50	9.606465	9.961290	9.645174	10.354826	1
24	9.609313	9.960730	9.648583	10.351417	6
10	9.612140	9.960165	9.651974	10.348026	5
20	9.614944	9.959596	9.655348	10.344652	4
30	9.617727	9.959023	9.658704	10.341296	3
40	9.620488	9.958445	9.662043	10.337956	2
50	9.623229	9.957862	9.665366	10.334634	1
		L. Sine.		L. Tang.	

	L. Sine.		L. Tang		
5	9.625948	9.957276	9.668672	10.331327	65
0	9.628647	9.956684	9.671963	10.328037	50
0	9.631326	9.956088	9.675237	10.324763	40
0	9.633984	9.955488	9.678496	10.321504	30
0	9.636623	9.954883	9.681740	10.318260	20
0	9.639242	9.954274	9.684968	10.315032	10
6	9.641842	9.953660	9.688182	10.311818	64
0	9.644423	9.953042	9.691381	10.308619	50
0	9.646984	9.952419	9.694566	10.305434	40
0	9.649527	9.951791	9.697738	10.302264	30
0	9.652052	9.951159	9.700893	10.299107	20
0	9.654558	9.950522	9.704036	10.295964	10
7	9.657047	9.949881	9.707166	10.292834	63
0	9.659517	9.949235	9.710282	10.289718	50
0	9.661970	9.948584	9.713386	10.286614	40
0	9.664406	9.947929	9.716477	10.283523	30
0	9.666824	9.947269	9.719555	10.280445	20
0	9.669225	9.946604	9.722621	10.277379	10
8	9.671609	9.945935	9.725674	10.274326	62
0	9.673977	9.945261	9.728716	10.271284	50
0	9.676328	9.944582	9.731746	10.268254	40
0	9.678663	9.943898	9.734764	10.265236	30
0	9.680982	9.943210	9.737771	10.262229	20
0	9.683284	9.942517	9.740767	10.259233	10
9	9.685571	9.941819	9.743752	10.256248	61
0	9.687842	9.941116	9.746726	10.253274	50
0	9.690098	9.940409	9.749689	10.250311	40
0	9.692339	9.939697	9.752642	10.247358	30
0	9.694564	9.938980	9.755584	10.244415	20
0	9.696774	9.938257	9.758517	10.241483	10
		L. Sine.		L. Tang.	

	L. Sine.		L. Tang.		
30	9.698970	9.937531	9.761439	10.238561	60
10	9.701151	9.936799	9.764352	10.234658	50
20	9.703317	9.936062	9.767255	10.232745	40
30	9.705469	9.935320	9.770148	10.229852	30
40	9.707606	9.934574	9.773033	10.226967	20
50	9.709730	9.933322	9.775908	10.224092	10
31	9.711839	9.933066	9.778774	10.221226	59
10	9.713935	9.932304	9.781631	10.218369	50
20	9.716017	9.931537	9.784479	10.215520	40
30	9.718085	9.930766	9.787319	10.212681	30
40	9.720140	9.929989	9.790151	10.209849	20
50	9.722181	9.929207	9.792974	10.207024	10
32	9.724210	9.928421	9.795789	10.204211	58
10	9.726225	9.927628	9.798596	10.201404	50
20	9.728227	9.926831	9.801396	10.198604	40
30	9.730216	9.926029	9.804187	10.195813	30
40	9.732193	9.925222	9.806971	10.193028	20
50	9.734157	9.924409	9.809748	10.190252	10
33	9.736109	9.923591	9.812517	10.187483	57
10	9.738048	9.922768	9.815279	10.184720	50
20	9.739975	9.921949	9.818035	10.181965	40
30	9.741889	9.921107	9.820783	10.179217	30
40	9.743792	9.920268	9.823524	10.176476	20
50	9.745683	9.919424	9.826259	10.173741	10
34	9.747562	9.918574	9.828987	10.171012	56
10	9.749429	9.917719	9.831709	10.168291	50
20	9.751284	9.916859	9.834425	10.165575	40
30	9.753128	9.915994	9.837134	10.162866	30
40	9.754960	9.915123	9.839838	10.160162	20
50	9.756781	9.914246	9.842535	10.157465	10
		L. Sine.		L. Tang.	

	L. Sine.		L. Tang.		
35	9.758591	9.913364	9.845227	10.154774	55
10	9.760390	9.912477	9.847913	10.152087	50
20	9.762177	9.911584	9.850593	10.149407	40
30	9.763954	9.910606	9.853268	10.146732	30
40	9.765720	9.909782	9.855937	10.144063	30
50	9.767474	9.908873	9.858602	10.141398	20
					10
36	9.769219	9.907958	9.861261	10.138739	54
10	9.770952	9.907037	9.863915	10.136085	50
20	9.772675	9.906111	9.866564	10.133436	40
30	9.774388	9.905179	9.869209	10.130791	30
40	9.776092	9.904241	9.871849	10.128151	20
50	9.777781	9.903298	9.874484	10.125516	10
37	9.779463	9.902349	9.877114	10.122885	53
10	9.781134	9.901391	9.879741	10.120259	50
20	9.782796	9.900433	9.882363	10.117637	40
30	9.784447	9.899467	9.884980	10.115020	30
40	9.786088	9.898494	9.887594	10.112406	20
50	9.787720	9.897516	9.890204	10.109796	10
38	9.789342	9.896532	9.892810	10.107190	52
10	9.790954	9.895542	9.895412	10.104588	50
20	9.792557	9.894546	9.898010	10.101990	40
30	9.794149	9.893544	9.900605	10.099395	30
40	9.795733	9.892536	9.903196	10.096803	20
50	9.797307	9.891522	9.905784	10.094215	10
39	9.798872	9.890503	9.908369	10.091631	51
10	9.800427	9.889476	9.910951	10.089049	50
20	9.801973	9.888444	9.913529	10.086471	40
30	9.803510	9.887406	9.916104	10.083895	30
40	9.805038	9.886361	9.918677	10.081323	20
50	9.806557	9.885311	9.921247	10.078753	10
		L. Sine.		L. Tang.	

	L. Sine.		L. Tang.		
40	9.808067	9.884254	9.923813	10.076186	50
10	9.809569	9.883191	9.926378	10.073622	50
20	9.810061	9.882121	9.928940	10.071060	40
30	9.812544	9.881045	9.931499	10.068501	30
40	9.814019	9.879963	9.934056	10.065944	20
50	9.815485	9.878875	9.936610	10.063389	10
41	9.816943	9.877780	9.939163	10.060837	49
10	9.818392	9.876678	9.941713	10.058287	50
20	9.819832	9.875571	9.944262	10.055738	40
30	9.821264	9.874456	9.946808	10.053192	30
40	9.822688	9.873335	9.949353	10.050647	20
50	9.824104	9.872208	9.951896	10.048104	10
42	9.825551	9.871073	9.954437	10.045562	48
10	9.826910	9.869933	9.956977	10.043023	50
20	9.828301	9.868785	9.959515	10.040485	40
30	9.829683	9.867631	9.962052	10.037947	30
40	9.831058	9.866470	9.964588	10.035412	20
50	9.832425	9.865302	9.967122	10.032878	10
43	9.833783	9.864127	9.969656	10.030344	47
10	9.835134	9.862946	9.972188	10.027812	50
20	9.836477	9.861757	9.974719	10.025280	40
30	9.837812	9.860562	9.977250	10.022750	30
40	9.839140	9.859360	9.979780	10.020220	20
50	9.840459	9.858150	9.982309	10.017691	10
44	9.841771	9.856934	9.984837	10.015163	46
10	9.843076	9.855710	9.987365	10.012635	50
20	9.844372	9.854480	9.989893	10.010107	40
30	9.845662	9.853242	9.992420	10.007580	30
40	9.846944	9.851997	9.994947	10.005053	20
50	9.848218	9.850745	9.997473	10.002527	10
60	9.849485	9.849485	10.000000	10.000000	45
		L. Sine.		L. Tang.	

	1 farthing	2 farthings	3 farthings
	li. sh. d. q.	li. sh. d. q.	li. sh. d. q.
1	1	2	3
2	2	1. 0	1. 1
3	3	1. 2	2. 1
4	1. 0	2. 0	3. 0
5	1. 1	2. 2	3. 3
6	1. 2	3 0	4. 2
7	1. 3	3. 2	5. 1
8	2. 0	4. 0	6. 0
9	2. 1	4. 2	6. 3
10	2. 2	5. 0	7. 2
20	5. 0	10. 0	1. 3. 0
30	7. 2	1. 3. 0	1. 10. 2
40	10. 0	1. 8. 0	2. 6. 0
50	1. 0. 2	2. 1. 0	3. 1. 2
60	1. 0. 3	2. 6. 0	3 9. 0
70	1. 5. 2	2. 11. 0	4 4. 2
80	1. 8. 0	3. 4. 0	5. 0. 0
90	1. 10. 2	3. 9 0	5. 7. 2
100	2. 1. 0	4. 2. 0	6. 3. 0
200	4. 2. 0	8. 4. 0	12. 6. 0
300	6. 3. 0	12. 6 0	18. 9. 0
400	8. 4. 0	16. 8. 0	1. 5. 0. 0
500	10. 5. 0	1. 0. 10. 0	1. 11. 3. 0
600	12. 6. 0	1. 5. 0. 0	1. 17. 6. 0
700	14. 7. 0	1. 9. 2. 0	2. 3. 9. 0
800	16. 8. 0	1. 13. 4. 0	2. 10. 0. 0
900	18. 9. 0	1. 17. 6. 0	2. 16. 3. 0
1000	1. 0. 10. 0	2. 1. 8. 0	3. 2. 6. 0
2000	2. 1. 8. 0	4. 3. 4. 0	6. 5. 0. 0
5000	5. 4. 2. 0	10. 8. 4 0	15. 12. 6. 0
10000	10. 8. 4. 0	20. 16. 8. 0	31. 5. 0. 0

A Table of Accounts.

	1 peny	2 pence	3 pense	4 pence
	li. ſh.d.	li. ſh.d.	li. ſh.d.	li. ſh.d.
1	1	2	3	4
2	2	4	6	8
3	3	6	9	1. 0
4	4	8	1. 0	1. 4
5	5	10	1. 3	1. 8
6	6	1. 0	1. 6	2. 0
7	7	1. 2	1. 9	2. 4
8	8	1. 4	2. 0	2. 8
9	9	1. 6	2. 3	3. 0
10	10	1. 8	2. 6	3. 4
20	1. 8	3. 4	5. 0	6. 8
30	2. 6	5. 0	7. 6	10. 0
40	3. 4	6. 8	10. 0	13. 4
50	4. 2	8. 4	12. 6	16. 8
60	5. 0	10. 0	15. 0	1. 0. 0
70	5.10	11. 8	17. 6	1. 3. 4
80	6. 8	13. 4	1. 0. 0	1. 6. 8
90	7. 6	15. 0	1. 2. 6	1.10. 0
100	8. 4	16. 8	1. 5. 0	1.13. 4
200	16. 8	1. 13. 4	2.10. 0	3. 6. 8
300	1. 5. 0	2. 10. 0	3.15. 0	5. 0. 0
400	1. 13. 4	3. 6. 8	5. 0. 0	6.13. 4
500	2. 1. 8	4. 3. 4	6. 5. 0	8. 6. 8
600	2. 10. 0	5. 0. 0	7.10. 0	10. 0. 0
700	2. 18. 4	5. 16. 8	08.15. 0	11.13. 4
800	3. 6. 8	6. 13. 4	10. 0. 0	13. 6. 8
900	3. 15. 0	7. 10. 0	11. 5. 0	15. 0. 0
1000	4. 3. 4	8. 6. 8	12.10. 0	16.13. 4
2000	8. 6. 8	16. 13. 4	25. 0. 0	33. 6. 8
5000	20. 16. 8	41. 13. 4	62.10. 0	83. 6. 8
10000	41. 13. 4	83. 6. 8	125. 0. 0	166.13. 4

A Table of Accounts.

	5 pence	6 pence	7 pence	8 pence
	li. sh.d.	li. sh.d.	li. sh.d.	li. sh.d.
1	5	6	7	8
2	10	1. 0	1. 2	1. 4
3	1. 3	1. 6	1. 9	2. 0
4	1. 8	2. 0	2. 4	2. 8
5	2. 1	2. 6	2.11	3. 4
6	2. 6	3. 0	3. 6	4. 0
7	2.11	3. 6	4. 1	4. 8
8	3. 4	4. 0	4. 8	5. 4
9	3. 9	4. 6	5. 3	6. 0
10	4. 2	5. 0	5.10	6. 8
20	8. 4	10. 0	11. 8	13. 4
30	12. 6	15. 0	17. 6	1. 0. 0
40	16. 8	1. 0. 0	1. 3. 4	1. 6. 8
50	1. 0. 0	1. 5. 0	1. 9. 2	1.13. 4
60	1. 5. 0	1.10. 0	1.12. 0	2. 0. 0
70	1. 9. 2	1.15. 0	2.0. 10	2. 6. 8
80	1.13. 4	2. 0. 0	2. 6. 8	2.13. 4
90	1.17. 6	2. 5. 0	2.12. 6	3. 0. 0
100	2. 1. 8	2.10. 0	2.18. 4	3. 6. 8
200	4. 3. 4	5. 0. 0	5.16. 8	6.13. 4
300	6. 5. 0	7.10. 0	8.15. 0	10. 0. 0
400	8. 6. 8	10. 0. 0	11.13. 4	13. 6. 8
500	10. 8. 4	12.10. 0	14.11. 8	16.13. 4
600	12.10. 0	15. 0. 0	17.10. 0	20. 0. 0
700	14.11. 8	17.10. 0	20. 8. 4	23. 6. 8
800	16.13. 4	20. 0. 0	23. 6. 8	26.13. 4
900	18.15. 0	22.10. 0	26. 5. 0	30. 0. 0
1000	20.16. 8	25. 0. 0	29. 3. 4	33. 6. 8
2000	41.13. 4	50. 0. 0	58. 6. 8	66.13. 4
5000	104. 3. 4	125. 0. 0	145.16. 8	166.13. 4
10000	208. 6. 8	250. 0. 0	291.13. 4	333. 6. 8

A Table of Accounts.

9 *pence*		10 *pence*		11 *pence*		12 *pence*	
li.	sh.d.	li.	sh.d.	li.	sh.d.	li.	sh.d.
1	9		10		11	1:	0
2	1:	6	1:	8	1:	10	2: 0
3	2:	3	2:	6	2:	9	3: 0
4	3:	0	3:	4	3:	8	4: 0
5	3:	9	4:	2	4:	7	5: 0
6	4:	6	5:	0	5:	6	6: 0
7	5:	3	5:	10	6:	5	7: 0
8	6:	0	6:	8	7:	4	8: 0
9	6:	9	7:	6	8:	3	9: 0
10	7:	6	8:	4	9:	2	10: 0
20	15:	0	16:	8	18:	4	1: 0: 0
30	1:	2: 6	1:	5: 0	1:	7: 6	1:10: 0
40	1:	10: 0	1:	13: 4	1:	16: 8	2: 0: 0
50	1:	17: 6	2:	1: 8	2:	5: 10	2:10: 0
60	2:	5: 0	2:	10: 0	2:	15: 0	3: 0: 0
70	2:	12: 6	2:	18: 4	3:	4: 2	3:10: 0
80	3:	0: 0	3:	6: 8	3:	13: 4	4: 0: 0
90	3:	7: 6	3:	15: 0	4:	2: 6	4:10: 0
100	3:	15: 0	4:	3: 4	4:	11: 8	5: 0: 0
200	7:	10: 0	8:	6: 8	9:	3: 4	10: 0: 0
300	11:	5: 0	12:	10: 0	13:	15: 0	15: 0: 0
400	15:	0: 0	16:	13: 4	18:	6: 8	20: 0: 0
500	18:	15: 0	20:	16: 8	22:	18: 4	25: 0: 0
600	22:	10: 0	25:	0: 0	27:	10: 0	30: 0: 0
700	26:	5: 0	29:	3: 4	32:	1: 8	35: 0: 0
800	30:	0: 0	33:	6: 8	36:	13: 4	40: 0: 0
900	33:	15: 0	37:	10: 0	41:	5: 0	45: 0: 0
1000	37:	10: 0	41:	13: 4	45:	16: 8	50: 0: 0
2000	75:	0: 0	83:	6: 8	91:	13: 4	100: 0: 0
5000	187:	10: 0	208:	6: 8	229:	3: 4	250: 0: 0
10000	375:	0: 0	416:	13: 4	458:	6: 8	500: 0: 0

Forreign Weights and Measures, carefully compared with the Engliſh.

	English Foot, into 1000 *equal parts.*	*English Foot, into* 100 *parts, and tenth parts of an inch.*	*The pound Averdupois into* 100 *parts.*
London Foot - -	1000	0:12:0	100
France.			
Paris, the Royal Foot	1:068	1:00:8	0:93
Lyon Ell - - -	3:976	3:11:7	1:09
Bologne Ell - - -	2: 76	2:00:8	0:89
The 17 Provinces.			
Amſterdam Foot - -	:942	0:11:3	0:93
Ell - -	2:269	2:03:2	
Antwerp Foot - -	:946	0:11:3	0:98
Ell - -	2:273	2:03:3	
Brill Foot - - -	1:103	1:01:2	
Dort Foot - - -	1:184	1:02:2	
Rynland or *Leyden* foot	1:033	1:00:4	0:96
Ell - -	2:260	2:03:1	
Lorain Foot - -	:958	:11:4	0:98
Mechalin Foot - -	:919	:11:0	0:98
Middleburg Foot -	:991	:11:9	0:98

Germany.	Thouſ. paris.	F. I p	Averd 100 p.
Strasbourgh Foot - -	:920	0: 11:0	0: 93
Bremen Foot - -	:964	0: 11.6	0: 94
Cologn Foot - - -	:954	0: 11:4	0: 97
Frankford ad Menam Foot - -	:948	: 11:4	0: 93
Ell - - -	1: 826	1: 9:9	
Humbrough Ell - -	1: 905	1: 10:8	0: 95
Leipſig Ell - - -	2: 260	2: 3:1	1: 17
Lubick Ell - - -	1: 903	1: 9:8	
Noremburgh - - -	1: 006	1: 00:1	0: 94
Ell - - -	2: 227	2: 3:3	
Bavaria - - - -	:954	0: 11:4	
Vienna - - - -	1: 053	1: 00:6	0: 83
Spain* and *Portu.			
Spaniſh palm, or the Palm of *Caſtile.*	:751	0: 09:0	0: 99
The *Spaniſh* Vare or Rod, four Palms)	3: 004	3: 00:0	
Their Foot is $\frac{1}{3}$ of the Vare - -	1: 001	1: 00:0	
Lisbon Vare - - -	2: 750	2: 09:0	1: 06
Gibralter Vare - -	2: 760	2: 09:1	1: 03
Toledo Foot - - -	:899	0: 10:7	1: 00
Vare - - -	2: 685	2: 08:2	
Italy.			
Roman Foot, on the Monum. of *Coſſutius*	:967	0: 11:6	1: 23
Of *Statilius* - -	:972	0: 11:7	
Roman Palm, for building, whereof ten make the *Cauna* - - -	:732	0: 08:8	

	Thouſ. parts.	F. In. p.	Aver. 100 p.
Bononia Foot - -	1:204	1:02:4	1:27
Ell - - -	2:147	2:01:7	
Perch, whereof 500 to a Mile - -	12:040	12:00:5	
Florence Brace or Ell	1:913	1:11:0	1:23
Naples Palm - - -	:861	0:09:6	1:43
Brace - - -	2:100	2:01:2	
Canna - - -	6:880	6:10:5	
Genua Palm - - -	:830	:09:6	1:42
Mantoua Foot - -	1:569	1:06:8	1:43
Milan Calamus - -	6:544	6:06:5	1:40
Parma Cubit - -	1:866	1:10:4	1:43
Venice Foot - - -	1:162	1:01:9	1:53
Other places.			
Dantzick Foot - -	:944	0:11:3	1:19
Ell - - - - -	1:903	1:10 8	
Copenhagen Foot - -	:965	:11:6	0:94
Prague (in *Bohemia*) Foot - - - -	1:026	1:00:3	1:06
Riga Foot - - -	1:831	1:09:9	
China Cubit - - -	1:016	1:00:2	
Turin Foot - - -	1:062	1:00:7	
Cairo Cubit - - -	1:924	1:09:9	1:61
Perſian Araſh - -	3:197	3:02:3	
Turkiſh Pike, at *Conſtantin.* the greater	2:200	2:02:4	0:86
The *Greek* Foot - -	1:007	1:00:1	
The Univerſal meaſure.	3:267	3: 3:2	

A *Penduluum* of the juſt length whereof will vibrate 60 times in a Minute.

To Gauge a Cask which is not full.

A Table for the Gauging of Wine Casks which are not full.

G.	parts	G.	parts	G.	parts	G	parts	G.	parts
0	000	13	2630	26	4338	39	5913	52	7672
½	295		2703		4400		5976		7758
1	470	14	2775	27	4462	40	6040	53	7829
	602		2847		4542		6094		7909
2	720	15	2918	28	4585	41	6158	54	7990
	830		2986		4646		6223		8072
3	935	16	3056	29	4706	42	6288	55	8154
	1038		3123		4766		6353		8236
4	1138	17	3189	30	4826	43	6418	56	8319
	1235		3255		4885		6483		8404
5	1339	18	3321	31	4943	44	6548	57	8491
	1420		3387		5000		6613		8580
6	1502	19	3452	32	5057	45	6679	58	8661
	1596		3517		5115		6745		8765
7	1681	20	3582	33	5174	46	6811	59	8862
	1764		3647		5234		6877		8962
8	1846	21	3712	34	5294	47	6944	60	9065
	1928		3777		5354		7012		9170
9	2010	22	3842	35	5415	48	7082	61	9280
	2091		3906		5476		7153		9398
10	2171	23	3960	36	5535	49	7225	62	9530
	2242		4024		5600		7297		9705
11	2328	24	4087	37	5662	50	7370	63	10000
	2405		4150		5724		7444		
12	2481	25	4213	38	5787	51	7519		
	2556		4276		5850		7595		

Like d. of l.	0	10	20	30	40	50	Like diff.
	A Table of Meridional Miles.						
0	0	10	20	30	40	50	10
1	60	70	80	90	100	110	10
2	120	130	140	150	160	170	10
3	180	190	200	210	220	230	10
4	240	250	260	270	280	290	10
5	300	310	320	330	340	350	10
6	360	370	380	390	400	410	10
7	421	431	441	451	461	471	10
8	481	491	501	511	521	532	10
9	541	552	562	572	582	592	10
10	603	613	623	633	643	653	10
11	664	674	684	694	704	715	10
12	725	735	745	755	766	776	10
13	786	797	807	817	827	838	10
14	848	858	869	879	889	900	10
15	910	920	931	941	951	962	10
16	972	983	993	1004	1014	1024	10
17	1035	1045	1056	1066	1077	1087	10
18	1098	1108	1119	1129	1140	1150	10
19	1161	1172	1182	1193	1203	1214	10
20	1225	1235	1246	1257	1267	1278	11
21	1289	1299	1310	1321	1332	1342	11
22	1353	1364	1375	1386	1396	1407	11
23	1418	1429	1440	1451	1462	1473	11
24	1484	1499	1505	1516	1527	1538	11
25	1549	1561	1572	1583	1594	1605	11
26	1616	1627	1638	1649	1661	1672	11
27	1683	1694	1705	1717	1728	1738	11
28	1751	1762	1773	1785	796	1808	11
29	1819	1830	1842	1853	1865	1867	11

A Table of Meridional Miles.

lve d. of l.	0	10	20	30	40	50	The diff.
30	1888	1899	1911	1923	1934	1946	12
31	1958	1969	1981	1993	2004	2016	12
32	2028	2040	2052	2063	2075	2087	12
33	2099	2111	2123	2135	2147	2159	12
34	2171	2183	2195	2207	2219	2231	12
35	2244	2256	2268	2281	2293	2305	12
36	2318	2330	2342	2355	2367	2380	12
37	2392	2405	2417	2430	2442	2455	12
38	2468	2481	2493	2506	2519	2532	13
39	2544	2557	2570	2583	2596	2609	13
40	2622	2635	2648	2662	2675	2688	13
41	2701	2714	2728	2741	2754	2768	13
42	2781	2795	2808	2822	2835	2849	13
43	2863	2876	2890	2904	2918	2932	14
44	2945	2959	2973	2987	3001	3015	14
45	3030	3044	3050	3072	3086	3101	14
46	3115	3130	3144	3159	3173	3188	14
47	3202	3217	3232	3247	3261	3276	15
48	3291	3306	3321	3336	3351	3366	15
49	3382	3397	3412	3428	3443	3459	15
50	3474	3490	3505	3521	3537	3553	16
51	3568	3584	3600	3616	3632	3649	16
52	3665	3681	3697	3714	3730	3747	16
53	3763	3780	3797	3814	3830	3847	17
54	3864	3881	3899	3916	3933	3950	17
55	3968	3985	4003	4020	4038	4056	18
56	4074	4092	4110	4128	4146	4164	19
57	4182	4201	4219	4238	4256	4275	19
58	4294	4313	4332	4351	4370	4390	19
59	4409	4428	4448	4468	4487	4507	20

Lat.	0	10	20	30	40	50	The Diff.
	A Table of Meridional Miles.						
60	4527	4547	4567	4588	4608	4629	20
61	4648	4678	4691	471	4733	4754	21
62	4775	4796	4818	4839	4861	4883	22
63	4905	4927	4949	4972	4994	5017	23
64	5039	5062	5085	5108	5132	5155	23
65	5179	5203	5226	5250	5275	5299	24
66	5324	5348	5373	5390	5423	5449	25
67	5474	5500	5520	5552	5678	5404	26
68	5631	5658	5685	5712	5739	5767	27
69	5795	5823	5021	5879	5908	5937	28
70	5066	5996	6125	6055	6085	6115	30
71	6146	6177	6208	6239	6271	6303	31
72	6335	6368	6401	6434	6468	6501	33
73	6535	6570	6605	6640	6675	6718	35
74	6747	6783	6829	6857	6895	6933	37
75	6972	7010	7 50	7089	7130	7170	40
76	7211	7253	7295	7338	7381	7424	43
77	7469	7513	7559	7605	7651	7698	46
78	7746	7795	7844	7894	7944	7996	50
79	8048	8100	8154	8209	8264	8320	55
80	8377	8435	8495	8555	8616	8678	60
81	8742	8806	8871	8939	9007	9077	68
82	9148	9221	9295	9371	9449	9528	77
83	9609	9692	9778	9865	9954	10046	88
84	10141	10238	10338	10441	10547	10656	105
85	10770	10887	11007	11133	11263	11398	128
86	11539	11686	11839	11999	12167	12344	165
87	12521	12718	12927	13150	13388	13644	220
88	13920	14221	14550	14914	15321	15783	386
89	16218	16950	17720	18729	20152	22623	

♈ H	♎ H	Com. parts. ′ ″	diff. ″	♉ H	♏ H	Com. parts ′ ″	diff. ″
—	—	———	———	—	—	------	———
1	0	12 3.40	220	1	13	55.25	230
2	0	12 7.20	220	1	13	59.15	231
3	0	12 11.10	220	2	14	3.06	231
4	0	12 14.40	220	2	14	6.57	232
5	0	12 18.20	220	2	14	10.49	233
—	—	———	———	—	—	------	233
6	0	12 22.00	220	2	14	14.42	233
7	0	12 25.41	221	2	14	18.35	234
8	0	12 29.22	221	2	14	22.29	234
9	0	12 33.03	221	2	14	26.23	235
10	0	12 36.44	221	2	14	30.18	236
—	—	———	———	—	—	------	237
11	0	12 40.25	222	2	14	34.14	237
12	0	12 44.07	222	2	14	38.11	238
13	0	12 47.49	222	2	14	42.08	239
14	0	12 51.31	222	2	14	46.06	239
15	0	12 55.13	223	2	14	50.05	239
—	—	———	———	—	—	------	241
16	0	12 58.56	223	2	14	54.04	241
17	1	13 2.39	223	2	14	58.05	243
18	1	13 6.22	224	3	15	2.06	241
19	1	13 10.06	224	3	15	6.07	243
20	1	13 13.50	224	3	15	10.10	243
—	—	———	———	—	—	------	244
21	1	13 17.34	225	3	15	14.13	244
22	1	13 21.19	225	3	15	18.17	244
23	1	13 25.04	226	3	15	22.21	245
24	1	13 28.50	226	3	15	26.26	246
25	1	13 32.36	227	3	15	30.32	247
—	—	———	———	—	—	------	248
26	1	13 36.23	227	3	15	34.39	248
27	1	13 40.10	228	3	15	38.47	248
28	1	13 43.58	229	3	15	42.55	249
29	1	13 47.47	229	3	15	47.04	249
30	1	13 51.36	229	3	15	51.13	249

	♊ H	♐ H	Com. parts. ′ ″	diff. ″		♑ H	♒ H	Com. parts. ′ ″	diff. ″
1	—	—	------		1	—	—	------	
1	3	15	55.23	251	6	18	4.21	262	
2	3	15	59.34	252	6	18	8.43	262	
3	4	16	3.46	250	6	18	13.05	262	
4	4	16	7.58	253	6	18	17.27	261	
5	4	16	12.11	253	6	18	21.48	261	
1	1	—	------		1	—	------		
6	4	16	16.24	254	6	18	26.09	261	
7	4	16	20.38	255	6	18	30.30	261	
8	4	16	24.53	255	6	18	34.51	260	
9	4	16	29.08	256	6	18	39.11	260	
10	4	16	33.24	256	6	18	43.31	260	
1	1	—	------	256	1	—	------		
11	4	16	37.40	257	6	18	47.51	260	
12	4	16	47.57	257	6	18	52.11	260	
13	4	16	46.14	258	6	18	56.31	259	
14	4	16	50.32	258	7	19	0.50	259	
15	4	16	54.50	259	7	19	5.09	258	
1	1	—	------		1	—	------		
16	4	16	59.09	259	7	19	9.27	258	
17	5	17	3.28	260	7	19	13.45	257	
18	5	17	7.48	260	7	9	18.02	257	
19	5	17	12.08	260	7	19	22.19	256	
20	5	17	16.28	260	7	19	26.35	256	
1	1	—	------	260	1	—	------		
21	5	17	20.48	260	7	19	30.51	255	
22	5	17	25.08	261	7	19	35. 6	255	
23	5	17	29.29	261	5	19	39.21	254	
24	5	17	33.50	261	7	19	43.35	253	
25	5	17	38.11	261	7	19	47.48	253	
1	1	—	------	261	1	—	------		
26	5	17	42.32	262	7	19	52.01	252	
27	5	17	46.54	262	7	19	56.13	252	
28	5	17	51.16	262	8	20	00.25	251	
29	5	17	55.38	262	8	20	4.36	250	
30	6	18	2.00	262	8	20	8.46		

	♌	♒	Com. parts.	diff.		♍	♓	Com. parts.	diff.
	H	H	′ ″	″		H	H	′ ″	″
1	—	—	------			—	—	------	
1	8	20	12.55	249		10	22	12.13	228
2	8	20	17.04	248		10	22	16.01	228
3	8	20	21.12	248		10	22	19.49	227
4	8	20	25.20	247		10	22	23.36	227
5	8	20	29.27	246		10	22	27.23	226
1	—	—	------			—	—	------	
6	8	20	33.33	245		10	22	31.09	226
7	8	20	37.38	244		10	22	34.55	225
8	8	20	41.42	244		10	2	38.40	225
9	8	20	45.46	244		10	22	42 25	225
10	8	20	49.50	243		10	22	46.10	224
1	—	—	------			—	—	------	
11	8	20	53.53	242		10	22	49.54	224
12	8	20	57.55	240		10	22	53 38	223
13	9	21	1.55	240		10	2	57.21	223
14	9	21	5.55	239		11	23	1.04	223
15	9	21	9.54	239		11	23	4 47	222
1	—	—	------			—	—	------	
16	9	21	13.53	238		11	23	8.29	222
17	9	21	17.51	237		11	23	12.11	222
18	9	21	21.48	237		11	23	15.53	221
19	9	21	25.45	236		11	23	19.34	221
20	9	21	29.41	235		11	23	23 15	221
1	—	—	------			—	—	------	
21	9	21	33.36	234		11	23	26.56	221
22	9	21	37.20	234		11	23	30.37	221
23	9	21	41.24	233		11	23	34.18	221
24	9	21	45.17	233		11	23	37.59	221
25	9	21	49.10	232		11	23	41.39	220
1	—	—	------			—	—	------	
26	9	21	53.02	231		11	23	45.19	220
27	9	21	56.53	231		11	23	48.59	220
28	10	22	0.44	230		11	23	52.39	221
29	10	22	4.34	230		11	23	56.20	220
30	10	22	8.24	230		11	23	00.00	220

A Table of the Longitudes, Latitudes, Right Ascensions, Declination of 100 of the most Notable Stars for Anno 1680, with the Difference for every Ten Years.

Mag.	Names of the Stars.	Longitude ° ′ ″	Latitude ° ′ ″
2	In the head of *Andr.*	♈09.52.09	25.42.10N
2	In her Girdle - -	♈25.54 06	[illegible]5.58.30N
2	In her Southern foot	♉09.44.5[illegible]	[illegible]7.47.10N
1	In *Aquar.* Femahant	♒29 9.49	2[illegible].59.40 S
3	In his right shoulde	♒28.15.03	10.42 15N
3	In his left shoulder	♒18.56.33	8.42.15N
5	In his left hand - -	♒11.56 33	04.50.15N
2	Br. ✳ in *Aqui. vul.*	♑27.15.23	29.20.40N
4	1. Horn ♈ - -	♈28.42.33	07.08.00N
4	2. Horn of ♈	♈29.28.33	08.28.30N
3	Bright ✳ in *Aries*	♉03.11 3	09.56.30N
1	*Auriga*, little Goat	♊17.[illegible]3.08	22.51.45N
2	In his right shoulder	♊26.55.08	21.25.40N
1	Bootes, *Arcturus*	♎19.47.33	31.00.40N
3	In his left shoulder	♎14.13.33	49.51.40N
neb	[illegible]n[illegible]er, *Præsepe* - -	♌02.51.[illegible]9	01.14 30N
	Canc. the Nor. *Asell*	♌03.01.59	03.08. [illegible]N
4	The Southern *Asell*	♌04.12.59	0[illegible].03.30 S
1	The G.dog ✳ *Sirius*	♋09 47 53	39 32.05 S
	The L. d. ✳ *Procyon*	♋21 23 23	15.57.10 S
3	*Capric.* the fore horn	♑[illegible]9. 7.3[illegible]	07.03.11N
3	the lower horn	♑29.40 33	04.4[illegible].10N
[illegible]	former in the tayle	♒17 23.33	02.24.50 S
	later in the tayle	♒19. 9.33	02.27.50 S
3	*Cass.* br. ✳ i'th' chair	♉00.38.53	51.17.00N
3	Brig. ✳ in her brest	♉03 2[illegible].33	46.36.50N
3	In the *bend of her hip*	♉09 32.33	48.47.50N
2	In her knee - - - -	♉13.26.0[illegible]	46.23.50N
2	*Cepheus* in his Girdle	♉01.19.33	71.08.30N
3	*Cet.* the Whales jaw	♉09 52.23	1[illegible] 3[illegible] 50 S
[illegible]	In the belly. North	♈17.31.21	20.17 2[illegible] S
[illegible]	The Nor. in the tayle	♓26.29.53	09.58.10 S
[illegible]	The Southern - - -	♓28.02.53	20.43.40 S
[illegible]	Nor. Cr, the bright ✳	♏07.45.36	44.25.20N

r.asc.in d.	r.asc.in ti.	Declination	diff.r.a.	dif.dec 10 y
o ″ ′	h ′ ″	o ′ ″	h ′ ″	″
357.58.44	23.51.55	27.20.38 N	0. 31	03. 24 A
12.54.44	51.39	33.56. 4 N	0. 33	03. 18 A
26.04.02	1.44.16	40.46. 0 N	0. 35	03. 00 A
339.54.00	22.39 36	31.14.10 S	0. 34	03. 00 S
327.20.55	21.49.24	1.49.32 S	0. 32	02. 54 S
318.39.42	21.14.39	6.53.58 S	0. 32	02. 36 S
307.30.42	20.30.03	10.37.32 S	0. 30	01. 54 S
293.47.23	19.35. 9	8. 3.56 N	0. 31	01. 18 A
24.00.26	1 36. 2	17.42.12 N	0. 33	03. 06 A
24.12.39	1.35.55	19.12 42 N	0. 33	02. 51 A
27.18.58	1.49.16	21.55.30 N	0. 34	02. 00 A
73.09 08	4.52.36	45.38 00 N	0. 33	01. 00 A
84.06.06	5.36.24	44.50.40 N	0. 47	00. 25 A
210.18.50	14. 1.15	20.53.56 N	0. 28	02. 57 S
214.50.09	14.19.2	39 00.26 N	0 25	02. 42 S
125.28.26	8.21.54	20.46.52 N	0. 35	01. 54 S
126.08.00	8.24 32	22.35.00 N	0. 36	02. 00 S
126.36 39	8.26.26	19 19 00 N	0. 35	02. 00 S
97.43.42	6.30.52	6.17.18 S	0. 27	00. 24 A
110.18 22	7.22.34	6. 1.36 S	0. 32	01. 12 S
300.07.34	20. 0.30	13.25.18 S	0. 34	01. 36 S
300.50.05	20. 3.20	15.41.26 S	0. 35	01. 42 S
320.29.17	21.22.37	17.59 33 S	0. 34	02 36 S
322.26.30	21.29.46	17.27.46 S	0. 34	02. 42 S
257 59.33	23 51.58	37.25.28 N	0. 30	03. 24 A
5.29.36	0.22 3	34.48.28 N	0. 33	03. 24 A
9.28.34	0.37.54	59. 0.48 N	0. 34	03. 24 A
16.17.00	1.05. 8	58.32.46 N	0. 38	02. 18 A
321. 2.06	21.24. 8	69.11.56 N	0. 9	02. 36 A
41.23.07	2.45 32	2.48.50 N	0. 30	02. 30 A
23.57.00	1.35.48	11.51.02 S	0. 30	03. 06 S
6.59.44	0.27 59	19.40.32 S	0. 31	03. 24 S
0.48.36	0. 3 14	10.31.50 S	0. 31	03. 30 S
230.26.00	15.21.44	7.49.32 N	0. 26	02. 06 S

A Table of the Longitudes, Latitudes, Right Aſcenſion, Declination of 100 of the moſt Notable Stars for Anno 1680, with the Difference for every Ten Years.

Mag.	Names of the Stars.	Longitude	Latitude
		° ′ ″	° ′ ″
3	In the Swans bill -	♍ 6:48:37	49:03:00 N
3	In her breſt - -	♒ 20:28:37	57:10:20 N
2	In her tayle - -	♓ 00:58:18	59:57:20 N
3	In her upper wing	♒ 11:57:53	64:23:50 N
3	In her lower - -	♒ 22:14:22	49:27:00 N
3	Bright ✶ in *Draco*	♐ 23:29:13	75:02:10 N
2	*Gemini*'s head of *Ca.*	♋ 15:44:53	10:02:50 N
2	*Gem.* head of *Pollux*	♋ 18:47:59	26:38:30 N
2	In the bright foot	♌ 04:34:53	06:48:00 S
3	*Hercules* his head -	♐ 11:41:1	37:22:15 N
3	In his right ſhoulder	♏ 26:37:43	42:47:15 N
2	In his left ſhoulder	♐ 10:20:13	47:46:15 N
1	*Hydra*'s Heart - -	♌ 22:49:43	22:23:50 S
1	*Lyons* Heart - -	♌ 25:21:38	00:26:20 N
1	*Lyons* Tayle - -	♍ 17:09:53	12:16:20 N
2	*Ly.* br. ✶ in his creſt	♌ 25:01:25	08:45:40 N
2	*Ly.* br. ✶ in his loins	♍ 06:50:38	14:18:30 N
3	*Ly.* i'th' top ot's neck	♌ 22:59:53	11:48:40 N
3	*Ly.* below in his neck	♌ 23:22:23	04:50:40 N
3	In the back o'th *hare*	♊ 15:12:13	43:55:50 S
2	Northern Ballance	♎ 14:55:2	08:33:30 N
2	Southern Ballance	♎ 20:39:32	00:25:10 N
1	Bright ſtar i'th' *hand*	♍ 10:49:33	61:47:10 N
3	i'th' head of *Ophiu.*	♐ 18:00:13	35:56:15 N
3	In his left hand - -	♎ 27:54:43	7:18:20 N
3	In his right knee -	♐ 13:34:13	07:17:20 N
3	In his left knee - -	♑ 04:49:13	11:29:20 N
3	In his right ſhoulder	♑ 20:55:13	28:00:20 N
4	*Ori.* i'th' top of his h.	♊ 19:17:53	13:25:30 S
2	*Orions* right ſhoulder	♊ 24:19:41	16:06:15 S
2	In his left ſhoulder	♊ 16:29:53	16:52:30 S
1	*Orions* Foot *Rigel*	♊ 12:19:03	31:10:10 S
2	Firſt of his belt - -	♊ 17:52 33	23:36:40 S
2	Second of his belt	♊ 18:56:48	24:34:10 S

Long. in d.	Right Ascension.	Declination.	Diff. R. A.	Add. or Sub.
° ′ ″	h ′ ″	° ′ ″	″	″
289:27:36	19:17:50	27:20:28 N	0: 24	01: 06 A
302:45:10	20:11:01	39:16:39 N	0: 21	01: 48 A
307:37:06	20:30:28	44:10:46 N	0: 20	02: 03 A
293:51:26	19:35:26	44:23:33 N	0: 29	01: 24 A
308:17:10	20:33:09	32:47:12 N	0: 24	02: 06 A
267:18:20	17:49:13	51:29:26 N	0: 14	00: 12 S
108:29:58	07:14:00	32:32:38 N	0: 41	01: 06 S
111:25:18	07:25:41	28:45:26 N	0: 38	01: 12 S
094:45:56	06:39:04	16:37:56 N	0: 35	00: 12 S
255:08:00	17:00:32	14:48:24 N	0: 27	00: 48 S
244:06:35	16:16:26	22:15:40 N	0: 26	01: 00 S
255:26:19	17:01:45	25:17:24 N	0: 21	00: 48 S
137:57:22	09:11:49	07:06:30 S	0: 30	02: 30 A
147:47:45	09:51:11	13:30:58 N	0: 33	02: 51 S
173:09:46	11:32:39	16:20:52 N	0: 31	03: 24 S
150:31:41	10:02:07	21:26:48 N	0: 34	02: 54 S
164:14:55	10:57:00	22:14:32 N	0: 35	03: 24 S
149:41:16	09:58:45	24:59:42 N	0: 35	02: 54 S
147:30:16	09:50:01	18:19:09 N	0: 35	02: 48 S
078:38:30	05:14:34	21:00:14 S	0: 26	00: 42 S
224:59:02	14:59:56	08:09:58 S	0: 32	01: 24 A
218:21:44	14:33:27	4:39:54 S	0: 33	01: 42 A
276:29:32	18:25:58	38:31:28 N	0: 20	00: 24 A
260:01:26	17:20:06	12:51:46 N	0: 28	00: 42 S
239:31:01	15:58:04	02:49:16 S	0: 33	01: 48 A
252:29:46	16:49:59	09:50:30 S	0: 20	01: 30 A
244:55:01	16:19:40	15:14:30 S	0: 33	01: 00 A
261:44:02	17:26:56	04:43:46 N	0: 09	00: 30 S
079:24:45	05:17:39	09:32:14 N	0: 33	00: 42 A
084:26:40	05:27:47	07:17:32 N	0: 33	00: 24 A
077:00:52	05:11:28	06:01:26 N	0: 31	00: 48 A
074:47:44	04:59:11	08:35:36 S	0: 30	00: 57 S
078:54:24	05:15:37	00:34:14 S	0: 31	00: 42 S
079:57:27	05:19:50	01:26:58 S	0: 31	00: 36 S

A Table of the Longitudes, Latitudes, Right Aſcenſion, Declination of 100 of the moſt Notable Stars for Anno 1680, *with the Difference for every Ten Years.*

Mag.	*Names of the Stars.*	*Longitude*	*Latitude*
		° ′ ″	° ′ ″
2	The 3*d* in *Orions* belt	♊ 20:06:03	25:21:10 S
3	*Pegaſus* in his mouth	♒ 27:18:17	22:06:10 N
2	In his thigh, *ſheat*	♓ 24:57:13	31:08:20 N
2	Bright ✶ in the wing	♓ 19:02:43	19:24:50 N
2	Br. ✶ i'th' lower w.	♓ 04:43:13	12:37:10 N
2	*Perſeus* in the ſide -	♉ 27:17:21	30:05:50 N
3	*Caput Meduſæ* - -	♉ 21:49:03	22:22:40 N
4	Southern fiſh *occiput*	♓ 16:56:05	07:17:00 N
3	Bright ✶ betwixt ♓	♈ 24:13:05	09:04:00 N
4	*Sagittar.* in his head	♑ 09:05:33	01:45:10 N
1	*Scorpions* heart - -	♐ 05:18:33	04:26:30 S
2	In his forehead *north*	♏ 28,40:03	01:06:55 N
3	In his foreh. middle	♏ 28:03:13	01:50:40 S
3	In his foreh. South	♏ 28:28:53	05:20:40 S
2	*Serpents* neck br. ✶	♏ 17:33:53	25:33:50 N
1	*Bulls* eye South - -	♊ 05:18:36	05:30:50 S
2	*Bulls* Northern eye	♊ 03:59:06	02:36:10 S
2	The loweſt of *Hiades*	♊ 01: 7:08	05:46:10 S
3	His Northern horn	♊ 18:05:52	05:20:30 S
3	His Southern horn	♊ 19:58:53	02:13:30 S
3	Brighteſt of the 7 ✶	♉ 25:37:43	03:59:00 N
1	Virgins Spike	♍ 19:22:53	01:59:30 S
3	Br. ✶ in her Girdle	♎ 07:01,52	08:40:30 N
3	*Vindimiatrix* - - -	♍ 05,28:23	10:15:00 N
2	Great Bears ſhoulder	♌ 10:41:32	49:40:10 N
2	Next under it - - -	♌ 14: 5:03	45:05:40 N
2	Br. ✶ hinder thigh	♌ 25:57:33	47:08:40 N
3	Bright ✶ on his back	♌ 6 33:03	51:27:10 N
2	In his Rump Aliot	♏ 04:19:33	54:17:45 N
2	Middle in the tayle	♏ 11:04:59	56.21:10 N
2	Laſt in the Tayle - -	♏ 22:20:13	54:24:10 N
2	The Pole Star - - -	♈ 24:09:53	65:59:50 N
2	Little Bears ſhoulder	♌ 08:28:13	72:48:40 N

asc. in d.	aj. in ti.	Declina. in.	diff. a	lif. dec.
o ′ ″	h ′ ″	o ′ ″	h ′ ″	′ ″
083:03:12	05.20.13	02.09 20 S	0. 30	00. 30 S
312.12:00	1.28.48	08.27.02 N	0. 31	02. 36 A
342:06:12	22.48.25	26.22 09 N	0. 29	03. 09 A
341:13:08	22 48.52	13.29 29 N	0. 30	03. 09 A
258:52:12	23.55 29	13 26.08 N	0. 20	03. 24 A
045:04 42	03.16.03	48.39.42 N	0. 35	02. 36 A
041:53:18	02.47.33	39.41.30 N	0. 39	02. 30 A
345:08:40	23.00.35	01.33.26 N	0. 39	03. 18 A
026:22:38	01.45.30	01.13.00 N	0. 32	03. 00 A
282:47:37	18.51.10	21.24.24 S	0. 47	00. 48 S
242:29:04	16.09.56	25.36.42 S	0. 37	01. 36 A
235:40:51	15.46.43	18.49.48 S	0. 35	01. 54 A
35:46:2	15.43.06	21.37.40 S	0. 36	02. 00 A
234:58:31	15.39.54	25.05.42 S	0. 39	02. 06 A
232:09:20	15.28,36	07.20.24 N	0. 30	02. 06 S
064:24:16	04.17 37	15.55.10 N	0. 34	01. 30 A
076:31:54	05.06.07	28.20.38 N	0. 39	00. 48 A
079:27:18	05.18 29	20 57.22 N	0. 36	00. 42 A
062..0.48	04.09 47	18.33.52 N	0. 34	01. 42 A
060.22.35	04.01.30	14.59.02 N	0. 34	01. 42 A
052.09.49	03.28.39	23.13.36 N	0. 35	02. 06 A
197.06.57	13.08.28	09.27.00 S	0. 31	03. 15 A
189.54.46	12.39.39	05.09 42 N	0. 21	02. 24 S
191.36.56	12.46 27	12.41.34 N	0. 31	03. 18 S
60.56.52	10.43.41	63.28.26 N	0. 40	03. 12 S
160.32.55	10.42.11	58.05.26 N	0. 39	03. 12 S
174.06.58	11.36.27	55.30.06 N	0. 33	03. 12 S
179.52.01	11.59.28	58.47.06 N	0. 32	03. 12 S
189.54.08	12.39.36	57.43.24 N	0. 27	03. 18 S
197.42.26	13.10.50	56.37.16 N	0. 25	03. 12 S
203.41.25	13.34.46	50.37.08 N	0. 24	03. 06 S
009.14.10	00.36.57	87.36.03 N	1. 16	03. 24 A
222.40.05	14.50.40	75.38.00 N	0. 01	00. 15 A

A most useful Table, whereby the true time of the Night may be known to a minut, without knowing the Meridian, height, or distance of the ✳.

Stars names that never set, and will be under the Pole Star.	*right asc. in time under the Pole* ✳	*d. in t. bet. the pole* ✳ *& pole*	*Azimuth under Pole* ✳	*from Meri.*	*Magnitude*
	h ′ ″	′ ″	o ′ ″		
1 *Cassiopeias* hip -	12,38,01	00,07	00,01,00	E	3
2 --- her knee - -	13,08,33	03,25	00,30,30	E	3
3 In *Persens* side -	15,15,39	14,40	02,21,30	E	2
4 Great Bears lip	20,12,11	08,19	01,42,20	E	4
5 In his left knee	21,16,04	11,59	01,51,30	E	3
6 Lower leader	22,53,21	11,08	01,33,40	E	2
7 Upper i'th' wain	22,55,42	12,07	01,29,30	E	2
8 The lower in □	23,42,52	06,26	00,57,00	E	2
9 The upper - -	00,21,33	02,05	00,35,20	E	2
10 Rump or Aliot	00,39,18	00,18	00,02,30	W	2
11 Last but one tay	01,07,09	03,40	00,25,00	W	2
12 Last of the tayl	01,19,05	05,40	00,55,00	W	2
13 Last turn of Dr.	01,48,12	10,52	01,14,4	W	2
14 Upper guard l.B	02,24,32	26,06	02,01,50	W	2
15 Lower of lit. B.	02,58,42	26,38	02,20,12	W	3
16 Br.✳ Drag.hea	05,25,26	23,17	03,42,44	W	2
17 Upp.turn of D.	06,38,11	34,54	03,51,20	W	3
18 *Cepheus* left sho.	08,43,06	27,20	03,10,20	W	3
19 In his Girdle -	08,55, 4	24,43	03,04,40	W	3
20 Right knee - -	11,10,02	17,31	01,21,40	W	3
21 *Cassiopeas* chair	11,41,37	10,21	00,48,20	W	3
22 In her breſt - -	12,20,56	01,32	00,15,20	W	3

Latitudes of Places

Arundel	51 00	London	51 32
Briſtoll	51 35	Lecester	52 45
Buckingham	52 10	Lincoln	53 20
Bedford	52 15	Lancaſter	54 15
Canterbury	51 25	Notingham	53 00
Cheſter	53 20	Northampt:	52 24
Colcheſter	52 08	Norwich	52 45
Cambridg	52 20	Newcaſtle	55 12
Carliſle	55 20	Oxford	51 50
Dover	51 20	Portsmou:	51 08
Dorcheſter	50 50	Plimouth	50 36
Darby	53 00	Reding	51 40
Durham	55 00	Salſbury	51 12
Dublin	54 27	Stafford	52 50
Exceter	50 50	Shroneſbu:	52 50
Edenbro:	56 00	Stanford	52 44
Falmouth	56 22	Wincheſte	50 20
Gloceſter	52 00	Worceſter	52 25
Huntington	52 30	Warwick	52 30
Ipsiwich	52 20	Yorke	54 00

1	6	8	3	1	6831
2	1/2	1	6	6	2 13662
3	1/8	2/4	2	9	3 20493
4	2/4	3	2	1/2	4 27324
5	3/0	4/0	1	5	5 34155
6	3/6	4/8	1	8	6 40986
7	4/2	5/6	2	1	7 47817
8	4/8	6/4	2	4	8 54648
9	5/4	7/2	2	7	9 61479

Fig. 1 for Repaires Rods.

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16) (17) (18) (19) (20) (21) (22) (23)

33.45